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# The UK Closed-End Fund Discount

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London Business School

Submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy

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# The UK Closed-End Fund Discount

## Abstract

A closed-end fund, referred to as an investment trust in the UK, is a collective investment company that typically holds other publicly traded securities. These funds are characterized by one of the most puzzling anomalies in finance - the existence and behaviour of the discount to net asset value (NAV). This study attempts to describe and characterise the discount on UK closed-end funds.

First we describe the industry and extensively review the literature on closed-end fund discounts. Second, we revisit one of the traditional theories of the discount - managerial performance - which claims that discounts reflect the perception of management ability to outperform relative to a passive portfolio. We define the value added by active management using two methodologies - Gruber's (1996) unconstrained multi-index regression and Sharpe's (1992) returns-based style analysis regression[*]. We show that discounts weakly reflect past performance, but do not seem to predict future managerial performance.

Analysis of the time-series behaviour of closed-end fund discounts shows that discounts are highly autocorrelated in their levels but not in their first differences. Nevertheless, we find weak evidence of price reversal. We also show that discounts have a tendency to revert to their mean and fluctuate around it within a certain range. Furthermore, there is strong evidence of discounts moving together.

An attempt is made to explain at least part of the largely idiosyncratic movements in the discount. Our model of the discount generating process measures the sensitivity of the changes in the discount to factors that measure the influence of the market, size, sentiment, mean-reversion, manager, past performance and reversal. We find that these seven factors explain, on average, 35 percent of monthly changes in the discount.

Finally, we investigate the behaviour of UK closed-end funds at the time of the IPO, of seasoned equity offerings (rights and "C" share issues) and of open-ending. We find that (i) share prices tend to decline after the IPO, (ii) funds tend to disappear after periods of poor NAV performance and (iii) funds with good past share price and NAV performance tend to have rights and "C" share issues.

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[*] M.J. Gruber (1996), *Another Puzzle: The Growth in Actively Managed Mutual Funds*, Journal of Finance and W.F. Sharpe (1992), *Asset Allocation: Management Style and Performance Measurement*, Journal of Portfolio Management.

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# Chapter 1

# Introduction

A closed-end fund, referred to as an investment trust in the UK, is a collective investment company that typically holds other publicly traded securities. Its purpose is to provide investors with two services - diversification and management. The closed-end fund is so-called because its capitalization is fixed, or "closed", which implies that the share supply is inelastic. Thus, the price is a function of the supply and demand for the shares trading on the market and has no direct link with the value of the assets corresponding to each share. To liquidate their holding, investors must sell their shares to other investors. An important characteristic that makes these securities unique is that they provide contemporaneous and observable market-based rates of returns for both stocks and underlying asset portfolios. Net asset value (NAV) is defined as the market value of the securities held less the liabilities, all divided by the number of shares outstanding. For many funds, the value of the portfolio is known with considerable accuracy since the component assets are quoted on the stock market. However, closed-end funds typically trade at a substantial discount to the underlying value of their holdings, the NAV of the fund.

Closed-end funds are characterized by one of the most puzzling anomalies in finance - the existence and behaviour of the discount to NAV. Closed-end fund shares are issued at up to a 10 percent premium to NAV. This premium represents the underwriting fees and start-up costs. Subsequently, within a matter of months, the shares trade at a discount, which persists and fluctuates according to a mean-reverting pattern. Upon termination (liquidation or 'open-ending') of the fund, the share price rises and the discount disappears.

This study focuses on the world's largest market for closed-end funds, the London Stock Exchange, and extends research previously carried out on the US market. Chapter 2 investigates the regulations associated with the UK investment and unit trust industries. Chapter 3 is a review of the literature and draws a comparison between the behaviour of the discount in the US and the UK markets. Despite some differences in leverage, taxation and ownership structure, the behaviour of UK discounts is in many respects similar to that in the US. Many theories suggest an explanation for the existence and behaviour of the discount, but since none solve all parts of the anomaly, some scholars have found it necessary to resort to models of investor irrationality. Chapter 4 describes some methodological issues relevant to the definition of the closed-end fund discount and the computation of total returns. We compare different definitions and discuss some choices for measuring the average discount for a category or group of funds. We also define measures of total returns for share prices, indexes and NAVs. The Chapter also reviews the databases available for analysing the discount of the UK investment trust industry.

Chapter 5 revisits one of the traditional theories for the existence of the discount - managerial performance. The conjecture that discounts reflect the quality of the management has been investigated in the past but the results were inconclusive. However, in these studies managerial performance is defined as the raw return on the fund's NAV, whereas we measure the manager's quality after adjusting for factor exposure. The value added by active management is defined using two methodologies: unconstrained multi-index regression and returns-based style analysis. The results contradict Gruber's (1996) evidence of managerial performance persistence in the US mutual fund industry. We find no performance persistence in the UK closed-end fund market. In terms of the pricing of these funds, we find no share price performance persistence. On the contrary, there is weak evidence of price reversal. Gruber (1996) argues that expectations of managerial performance should be incorporated in the price of closed-end funds. However, we find no evidence that discounts predict managerial performance. Finally, we investigate the relationship between a fund's residual risk and its discount. If there is a cost to arbitrage, the greater the difficulty to hedge, the larger the discount. We find evidence supporting this hypothesis and confirm Pontiff's (1996) results.

Chapter 6 analyses the time series behaviour of the discount in terms of autocorrelation, stationarity, mean-reversion and cointegration. The idea is to identify the factors that might drive the model of the discount generating process analysed in Chapter 7. The results show that discounts are highly autocorrelated in their levels but not in their first differences. Nevertheless, we find weak evidence of price reversal. The analysis also shows that UK closed-end funds have a tendency to return to their mean and fluctuate around it within a certain range. Furthermore, there is strong evidence of the UK closed-end fund discounts moving together. Based on these results we identify two attributes that are likely to be significant in the model of the discount generating process analysed in the following chapter: (i) discounts move together and (ii) discounts are characterised by some degree of reversal.

Chapter 7 extends the analysis of the time-series behaviour of closed-end fund discounts and attempts to develop a model of the discount generating process. Based on the results of Pontiff (1997), we first take into account market risk, small firm risk, and sentiment risk. An attempt is made to explain at least part of the largely idiosyncratic movements in the discount by introducing additional factors. We investigate the importance of mean-reversion, manager, past performance and price reversal measures. The results show that this extended palette of factors can explain approximately 35 percent of the changes in the discount.

Chapter 8 presents opportunities for future research. We investigate the performance of UK closed-end funds at the time they are issued and when they are terminated (open-ending). The results show that the price decline during the first years of trading is higher than for industrial IPOs, but bears some similarities. The evidence tends to suggest that the same IPO puzzle pertains to closed-end funds as to industrial companies. The second part of the chapter focuses on the departures of funds from the industry. The funds that disappear seems to be characterised by a poor market adjusted NAV performance during the 5 years before the termination of the fund. Finally, we investigate seasoned equity offerings. We find that funds with good past share price and NAV performance tend to have rights and "C" share issues. The evidence suggests that new money flows to well managed funds. Chapter 9 concludes.

# Chapter 2

# Investment And Unit Trust Regulations

## 1. Introduction

An investment trust is a company whose operations are similar to those of any business corporation. It is different only because its corporate business consists largely of investing its funds in the securities of other corporations[1] and managing these investment holdings for income and profit. An important characteristic that makes investment trusts unique is that they provide contemporaneous and observable market-based rates of return for both stocks and underlying asset portfolios. The investment trust is referred to in the US as a closed-end fund because its capitalisation is fixed, or "closed"[2], which implies that the supply of investment trust shares is inelastic. Thus, the price is a function of the supply and demand for the shares trading on the market and has no direct link with the value of the assets corresponding to each share. The fixed size of the fund makes it easier for managers to make long term commitments. Investors have access to independent boards of directors and the company's activities are governed by Company Law and Stock Exchange regulations. In contrast, unit trusts, referred to in the US as an open-end funds or, more commonly, mutual funds, are characterised by the continual selling and redeeming of their units at or near net asset value[3] (NAV) and this at the request of any unitholder. Therefore, the trusts have a variable capitalisation. Unitholders have a share in the collective rights of the fund's assets and an independent trustee acts on their behalf to supervise the manager of the portfolio. The unit trust is regulated according to rules laid down by the Security and Investment Board (SIB) and other regulating organisations.

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[1] Brickley, Manaster, Schallheim (1991) report for their sample of funds that, on average, nearly 80 percent of the funds' assets consisted of actively traded equities with reliable market prices.

[2] The capital structure can be modified by approval of the existing shareholders. Secondary issues may occur and in the UK closed-end fund market we report approximately 110 rights issues over the period 1980-1997. Burch and Weiss Hanley (1996) show that, based on a sample of 85 US closed-end

Since the launch of the first investment trust by Foreign & Colonial in 1868, the British closed-end fund industry has grown considerably. Over the past decade, capital has been raised for investments in specialized areas or for special purposes, rather than for traditional, internationally diversified funds[4]. Currently there are around 360 funds, with a total market capitalisation of over £47 billion. Each of the funds is allocated to one of the 20 categories described in Table 2.1[5]. The investment trusts are typically members of the Association of Investment Trust Companies (AITC) which was formed in 1932 to protect and promote such funds. In 1997 approximately 87 percent of the funds were members of the AITC.

---

fund rights offers issued between 1985 and 1994, managers tend to time rights offers to coincide with periods of high demand and when funds trade at a premium.

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

[4] The removal of British exchange control restrictions in 1979 and the globalisation of world stock markets made it easier for investors to acquire overseas securities without having to invest through closed-end funds. Subsequently, during the period of reorganization of the early 1980s, many investment trust managers concluded that investors needed more specialisation.

[5] For simplicity we describe the category mnemonics excluding the first two digits 'IT' which refer to the 'Investment Trust' sector (i.e. ITINGN is the full mnemonic of the International General category).

Table 2.1. Categories of UK Closed-End Funds - March 1997

| | Category | Mnem. | Investment policy | Number | £bn |
|---|---|---|---|---|---|
| 1 | International General | INGN | < 80% in any one geographical area | 17 | 9.3 |
| 2 | International Capital Growth | INCG | < 80% in any one geographical area. Policy to accentuate capital growth | 25 | 4.5 |
| 3 | International Income Growth | INIG | 80% in any one geographical area Policy to accentuate income growth | 4 | 1.4 |
| 4 | UK General | UKGN | > 80% in UK-registered companies | 13 | 2.4 |
| 5 | UK Capital Growth | UKCG | > 80% in UK-registered companies Policy to accentuate capital growth | 13 | 1.1 |
| 6 | UK Income Growth | UKIG | > 80% in UK-registered companies Policy to accentuate income growth | 16 | 3.3 |
| 7 | High Income | HIGH | > 80% in equities and convertibles Yield 25% above FTSE All-Share | 14 | 0.6 |
| 8 | Closed-End Funds | CLOS | > 80% in investment trusts and other closed-end investment companies | 8 | 0.4 |
| 9 | Smaller Companies | SMCO | > 50% invested in the shares of smaller and medium sized companies | 43 | 3.9 |
| 10 | North America | NTHA | > 80% of their assets in North America | 11 | 1.0 |
| 11 | Far East excluding Japan | FARE | > 80% of their assets in Far East securities, with exception of Japan | 29 | 2.3 |
| 12 | Far East including Japan | FEJP | > 80% in Far East securities but less than 80% in Japan | 6 | 1.5 |
| 13 | Japan | JAPN | 80% of their assets in Japan | 16 | 1.1 |
| 14 | Continental Europe | EURO | > 80% of their assets in Continental Europe | 20 | 1.8 |
| 15 | Pan Europe | PANE | > 80% in Europe (including UK) with at least 40% in Continental Europe | 3 | 0.9 |
| 16 | Property | PROP | 80% of their assets in listed Property shares | 4 | 0.2 |
| 17 | Commodity & Energy | COMM | > 80% of their assets in listed Commodity & Energy shares | 3 | 0.5 |
| 18 | Emerging Markets | EMRG | > 80% of their assets in emerging markets | 33 | 3.0 |
| 19 | Venture & Development | VENT | A significant portion invested in the securities of unquoted companies | 25 | 5.1 |
| 20 | Split Capital Trusts | SPLIT | Funds with a fixed winding-up date and more than one class of equity capital | 62 | 3.0 |
| | **Total** | | | **365** | **47.3** |

Sources: NatWest Securities (January 1997) and London Business School Risk Measurement Service (January-March 1997).

In contrast, the total market capitalisation of UK unit trusts is approximately £150 billion. Unit trusts are typically members of the Association of Unit Trusts and Investment Funds (AUTIF). Each of the funds is allocated to one of 24 categories listed in Table 2.2. As a comparison, discussions with representatives from Crédit Lyonnais Laing have indicated that the total market capitalisation of the US closed-end and mutual fund industry is approximately £10 billion and £2,300 billion, respectively.

The popularity of unit trusts is related to the fact that they are relatively simple for the small investor to understand, they are easy to buy and sell, and from the management's point of view, they are straightforward to promote and profitable to run. Investment trusts share none of these advantages. They are more complex to understand, there are severe restrictions on how they can be promoted, and before the introduction of the savings schemes in 1984, they were much more difficult to buy and sell. But, these are not the only comparisons that matter and the following sections will show some of the advantages of the investment trust companies. The chapter focuses on UK investment trusts, but differences are drawn with the equivalent US closed-end funds.[6]

Table 2.2. Categories of Unit Trusts that are Members of the AUTIF - June 1997

| | Category | Investment policy | Number | £bn |
|---|---|---|---|---|
| 1 | UK Growth & Income | > 80% in UK equities Yield between 80 to 110% of FTSE All-Share. Policy to provide both income and capital growth | 163 | 27.3 |
| 2 | UK Equity Income | > 80% in UK equities Yield >110% of FTSE All-Share | 86 | 15.1 |
| 3 | UK Growth | > 80% in UK equities Policy to accentuate capital growth | 158 | 21.6 |
| 4 | UK Smaller Companies | > 80% in UK equities included in the FTSE Small Cap Index | 77 | 9.0 |
| 5 | UK Gilts and Fixed Interest | > 80% in UK fixed interest securities, including gilts and UK corporate fixed interest securities | 107 | 6.0 |
| 6 | UK Equity & Bonds | > 80% in the UK, but < 80% in either UK fixed interest securities or in UK equities Yield up to 120% of FTSE All-Shar | 23 | 3.1 |
| 7 | UK Equity & Bonds Income | > 80% in the UK, but < 80% in either UK fixed interest securities or in UK equities Yield up to 120% of FTSE All-Shar | 46 | 3.0 |
| 8 | International Equity Income | > 80% in equities from all over the world. Yield > 110% of FTSE World Index | 9 | 0.5 |
| 9 | International Growth | > 80% in equities from all over the world. Policy to accentuate capital growth | 174 | 17.5 |
| 10 | International Fixed Interest | > 80% in fixed securities from all over the world | 39 | 1.2 |
| 11 | International Equity & Bond | > 80% in either equities or fixed interest securities from all over the world | 38 | 2.5 |
| 12 | Global Emerging Markets | > 80% directly or indirectly in emerging markets | 20 | 1.4 |
| 13 | Japan | > 80% in Japanese securities | 96 | 6.4 |
| 14 | Far East Including Japan | > 80% in Far Eastern securities, but < 80% in Japanese securities | 39 | 2.3 |
| 15 | Far East Excluding Japan | > 80% in Far Eastern securities, excluding Japan | 80 | 8.9 |
| 16 | North America | > 80% in North America equities | 125 | 6.7 |
| 17 | Europe | > 80% in European securities, but < 80% in UK securities | 131 | 16.0 |
| 18 | Commodity & Energy | > 80% in commodity or energy securities | 11 | 0.3 |
| 19 | Property | > 80% in financial or property securities | 8 | 0.2 |
| 20 | Investment Trust Units | Invest only in investment trust companies | 12 | 1.0 |
| 21 | Fund of Funds | Invest only in other authorised unit trust schemes | 84 | 7.2 |
| 22 | Index Bear Funds | Designed to inversely track the performance of an index by using derivatives | 14 | 0.0 |
| 23 | Money Market | > 80% in money market instruments | 30 | 0.6 |
| 24 | Pensions | Available for use in a unit trust personal pension plan scheme | 42 | 0.2 |
| | **Total** | | **1612** | **150.9** |

Source: AUTIF (1997).

## 2. The Investment Trust Discount

One important characteristic that sets investment trusts apart from other collective investment schemes is the mismatching between the trusts' share prices and the value of their underlying investments; thus, the trusts' share prices trade at a discount or premium to NAV. Investors therefore, potentially have two ways of making money: from any increase in the value of the underlying investments, and from any narrowing of the discount.

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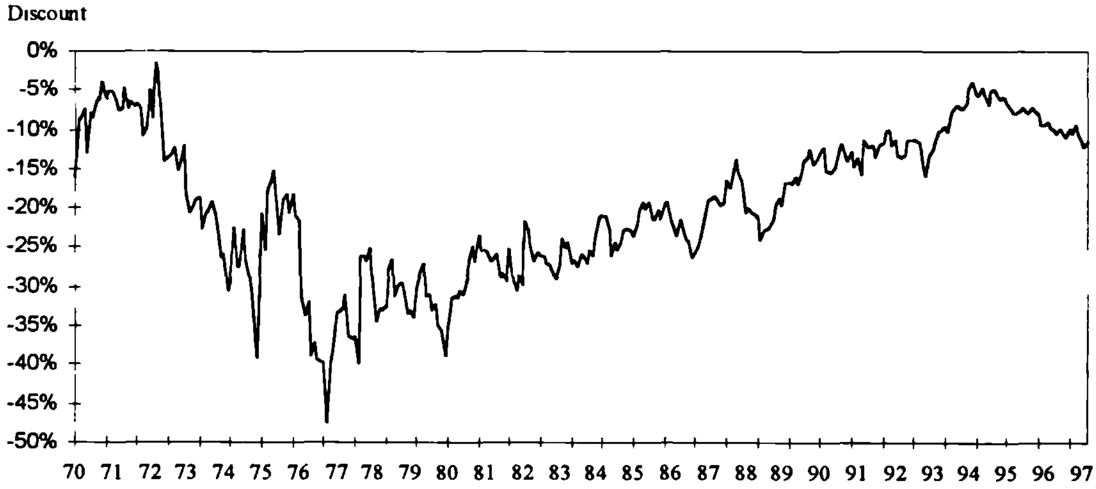
[6] The paper is compiled by reviewing published material (Arnaud (1983), Masey (1988), Draper (1989), Anderson and Born (1992), AITC Complete Guide to Investment Trusts (1997), AUTIF Unit Trusts User's Handbook (1997)), soliciting publications from investment organisations (Crédit Lyonnais Laing Investment Trust Yearbook 1997) and trade organisations and by interviewing several investment trust professionals. In this connection I wish to thank Lewis Aaron (Warburg), Hamish

The history of the UK investment trust discount and premium mirrors the popularity of these funds. In the 1960s, when investment trusts were still popular with private investors, the average discount fluctuated 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 to nearly 50 percent. The bull market of the 1980s and the introduction of new classes of shares, savings schemes and PEPs, renewed interest in investment trusts. By the end of 1993, the average discount had gradually narrowed to approximately 5 percent, but in the last few years the trend seems to have been reverting, as illustrated in Figure 2.1.

Figure 2.1. UK Investment Trust Industry - Average Discount 1970-97

The average discount of UK investment trusts increased dramatically during the first half of the 1970s. Since then it has declined from more than 40 percent to less than 10 percent today. The industry discount is expressed as the logarithm of the average ratio of Share Price to NAV (see Equation (4.4)).



Source: Author's calculations using data from Datastream

The causes of the discount have been widely discussed: the discounted cost of management fees, the gearing of the trusts, valuation problems and many other possible explanations have all been suggested. The existence of substantial discounts

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Buchan (NatWest Securities), James Rath (AITC) and Michael Oliver (Hill Samuel Investment Managers).

together with legal and fiscal constraints have resulted in a relative decline of the investment trust industry. Despite the recent reversion of the trend, the reduction in private sector shareholdings is sometimes suggested as a cause of the discount since a rationale for the existence of investment trusts is the provision of diversification at low cost.

## 3. Ownership

Investment trusts continued to be popular with private investors right up until the beginning of the 1970s. But competition from alternative forms of investments made it increasingly difficult to persuade private investors to put their money at risk in the stock market. At the same time, large institutional investors - insurance companies and pension funds - became interested in the expertise that investment trusts could provide to manage this new influx of funds coming from the private sector. The investment trusts largely switched their promotional efforts from individual investors to the institutions. The launch of the first split capital trust in 1965, began a short-lived attempt at revitalising the entire investment trust industry but, by the middle the 1970s, investment trusts were deserted by private as well as institutional investors. This lack of popularity made the average discounts to NAV increase to nearly 50 percent and led to a number of takeover bids.

The ownership structure of investment trusts has changed considerably over the years. In 1964 individuals held almost 60 percent of the trusts but, 20 years later, their stake was less than 25 percent (Draper (1989)). On the other hand, over the same period of time, pension fund holdings grew from almost zero to more than a quarter of the value of the trusts[7]. The increase in the proportion of institutional shareholders - in 1990, 70 to 75 percent of the investment trusts' shares were owned by institutions - has resulted in pressure on the trusts to perform. Despite the large presence of pension funds, the natural owners of investment trust shares are life insurance companies. Their trading in shares through investment trusts has the advantage that, since 1980, any capital gains realised within the trust is tax exempt[8]. Thus the tax shield tends to offset the costs of the fund's management.

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[7] The Finance Act of 1980 exempted approved investment trusts from tax on capital gains. The changes made it more profitable for pension funds, which are zero-bracket shareholders, to invest in the shares of investment trusts.

Institutional ownership has, however, began to decrease and individual investors are now more present in the investment trust industry, particularly after the introduction of savings schemes in 1984; in 1997 institutional ownership of investment trusts stood at approximately 65 percent (Crédit Lyonnais Laing Investment Trust Yearbook (1997)). The diversification of assets provided by the investment trusts has become less interesting for institutional shareholders who can perform this function for themselves. Pension funds are gradually selling their shares in the 'general' investment trusts and concentrating their holdings in the more specialised ones[9]. In contrast, life insurance companies are stuck with their holdings to avoid large capital gains tax liabilities.

## 4. Capital Structure

In addition to reorganising a trust's holdings, some investment trust managers devised new ways of investing in the trusts. Different classes of investment are now available:

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[8] Life insurance companies have a very distinct reason for holding investment trusts. Investment trusts are tax exempt on capital gains realised within the fund. In contrast, life insurance companies are subject to unrealised capital gains liabilities. Investment gains are taxed in different ways according to the category of business to which they are allocated - either life assurance, pension or health insurance business. For the pension business, the policy holders are tax-exempt, but the insurance company is still taxed on any trading profits which it derived from pension related transactions and gains are taxed whether they are realised or unrealised. For the amounts allocated to the life assurance category, sales of equity holdings and properties are taxed on realised capital gains. Gilt holdings, on the other hand, are taxed on both realised and unrealised capital gains (gains are measured using one of the two authorised accounting methods, mark-to-market or accruals). The health insurance business is taxed only on realised gains (see Arkle (1997)).

ordinary shares, ordinary highly geared shares (shares in a company with a wind-up date designed to give shareholders a highly geared return both in terms of capital and income), income shares (shares that are entitled to the surplus income after expenses and after the income requirement of any prior charge has been met), capital shares (shares that are entitled to the surplus assets on wind-up after repayment of other share classes), zero dividend preference shares (shares that have a pre-determined rate of capital growth), stepped preference shares (shares with a pre-determined growth in both income and capital), warrants and convertibles.

During the last decade, several investment trust managers have attempted to reduce the discount on their existing trusts by converting them into split capital trusts which offer two (income and capital shares) and sometimes more (stepped and zero-dividend preference shares) classes of shares.

### 4.1. Borrowings

As they are generally forbidden by statute or by-law to sell senior securities[10], unit trusts offer a single class of investment; only investment trusts make important use of leverage through their own capital structures[11]. Gearing increases the holdings of an investment trust. However, the risk of highly geared 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 trusts operate with very low levels of gearing and the limits in leverage have rarely been reached. A factor that dissuades investment trust managers from introducing or increasing the level of gearing is their implicit

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[9] If pension funds require exposure to a specific market (e.g. to the Far East) but have no stock-selection capacity and no desire to appoint specialist managers for each asset sub-category, there are managerial advantages to invest in specialised funds.

[10] UK unit trusts are generally prohibited from borrowing money, which implies that unitholders' interests vary directly with the value of their proportionate part of the fund, subject only to adjustments of the bid or offer calculations.

commitment towards shareholders to increase or at least maintain dividend payments. The additional debt financed dividend income is insufficient, at least initially, to pay the interest on borrowings and dividends on ordinary shares may have to be reduced. A solution to this problem was Scottish Mortgage's introduction of the first stepped interest debenture stocks in October 1982. These offer an increasing rate of interest - the rate starts low and is stepped up annually until it reaches a pre-determined maximum. Pension funds, more than private investors, are interested in this increasing yield.

Another class of debenture is the equity linked loan stock. A number of investment trusts, such as British Assets and Scottish American, issued a loan stock designed to perform in line with an equity index such as the FTSE All Share index. The loan stock is guaranteed to perform in line with the index in terms of the running yield and final redemption. In 1993, Hoare Govett launched a new investment trust designed to match the performance of their Smaller Companies Index.

Gearing through foreign currency loans is a way of managing the foreign exchange risk related to overseas holdings. If the investment trust wants to match its foreign assets with foreign liabilities, without increasing the trust's gearing, it can take a back-to-back loan (the foreign loans are matched by UK deposits) or it can hedge by means of forward contracts. Unit trusts, on the other hand, are restricted to back-to-back loans, as the only method for managing foreign exchange risk exposure.

## 4.2. Dual purpose funds

The most common split capital trusts are capitalised with two types of claims, income and capital shares, and usually have a fixed termination date. Income shares receive all dividend and interest income generated by the entire portfolio of securities held by the fund as it accrues and have a predetermined redemption price when the fund

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[11] In contrast, US closed-end funds are not allowed to borrow.

terminates. All realised capital gains are reinvested in the fund. 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 trust's portfolio. Some of the income shares have a right to part of the capital growth, but most of the capital shares have no entitlement to a share in the income. The split level concept had immediate attraction for income seekers and high-rate tax payers. In fact, a possible reason for the existence of investment trusts is to intermediate investment income[12] among investors in different tax brackets[13]; the most extreme form being the 'split-capital trusts'[14].

Despite the advantages of these trusts, the structure of the early split trusts has proved to be less than ideal in practice. Capital shares start trading at very high discounts during the years following the initial public offering (IPO). This progressively narrows as the winding-up date approaches. Over the long term, however, the performance of these shares has been outstanding. The income shares have turned out to be less attractive. In the early years following the IPO, the price of the income shares tends to rise above their redemption value as the stream of dividend income increases. As the winding-up date approaches, the shares fall back again because they are to be repaid at their initial subscription price or par[15]. Income shares, however, can perform very well if interest rates fall and they have important defensive qualities. In declining markets they fall less sharply than investment trust shares as a whole and much less than their capital share counterparts[16]. Emerson (1994) provides a generalised formula for pricing split-level investment trusts.

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[12] Idiosyncratic bankruptcy risk might deter individual firms from collectively achieving the optimal amount of gearing in relation to the tax system. The investment trust, by diversifying this risk, can gear more cheaply than its portfolio constituents. For the funds, debentures are priced at yields only slightly higher than UK government bonds.

[13] Both tax-exempt pension funds and high-rate tax payers hold substantial proportions of investment trust shares.

[14] Intermediation also explains some PEP-based structures: income units in a PEPs and capital gains using up each person's annual allowance.

[15] 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 where 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

Split capital trusts are effectively a way of introducing an element of gearing without borrowing any money. Capital shareholders have a residual claim on the value of the trust at the winding-up date, after the income shareholders have been repaid. An additional element of gearing is often introduced by issuing a greater number of income shares than capital shares. The introduction in 1987 of two more classes of shares, stepped and zero-dividend preference shares, resulted from the need to further increase the gearing level of the trust.

### 4.3. Preference shares

Some investment trusts issue preference shares. They are designed to offer a low risk investment and are usually the first class of shares to be repaid whenever the fund is wound up. The income on the shares is fixed when they are first issued. In most cases the income or the yield is higher than the income paid on ordinary shares. In May 1987, River & Mercantile launched the first stepped preference share. This class of shares offers dividends which rise at a predetermined rate, together with a fixed redemption value which is paid when the trust is wound up. In September 1987, Scottish National went one step further and introduced the zero-dividend preference share. This share offers a fixed capital return in the form of a redemption value, paid when the trust is wound up. Zero-dividend preference shares have no entitlement to dividends.

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trust discount is computed by summing the market capitalisations of all classes of shares and comparing it to the sum of the net assets attributable to each class.

[16] The elimination, in March 1988, of differential taxing of capital gains and income had a strong impact on income and capital shares. Income shares rose strongly, as income became as 'tax attractive' as capital profit, whereas discounts on capital shares widened.

### 4.4. Warrants

Warrants are long term traded options and give the right to buy shares at some time in the future at a price fixed when the warrants are first issued. They are essentially call options. Warrants do not form part of the company's issued share capital and they are usually not entitled to dividends until exercised (a recent exception to the rule is the "subscription share" which has all the features of a conventional warrant, but also pays dividends). In November 1997 there were around 140 investment trust warrant issues in the market. Most investment trusts include warrants with their share capital when they are first launched. Typically an investor might be offered one warrant for every five shares. Most warrants are "free" and are intended to compensate for any downward move in the share price from that paid at launch. Investors can sell warrants once they are traded in their own right, separate from the shares. Warrants can also easily be repurchased.

## 5. Buying and Selling Shares and Units

The investment trust[17] differentiates itself from the unit trust by the trading of the shares after the initial offering. The investment trust's shares are traded on organised exchanges, like those of any other company. Thus, when an investor buys shares in this fund, he must generally buy them from an existing holder and not from the manager or its agents as is the rule in unit trusts. The investor does not have the right to ask the investment trust to redeem or sell more of his or her shares.

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[17] Section 842 of the Income and Corporate Taxes Act 1988 defines an 'investment trust' as follows:

- The company is resident in the UK
- The company's income is derived wholly or mainly from shares or securities
- No holding in a company, other than an investment trust or a company which would qualify as an investment trust but is not quoted on the London Stock Exchange, represents more than 15 percent by value of the investing company's investments
- The ordinary shares are quoted on the London Stock Exchange
- The distribution as dividends of capital gains arising from the realisation of investments is prohibited
- The company does not retain in respect of any accounting period more than 15 percent of the income it derives from shares and securities.

Units trusts are usually bought or sold directly from the managers and this has been a determinant factor behind their success. In contrast, investment trust shares used to be bought through stockbrokers. However, the introduction of savings schemes allows small investors to deal directly with managers. Investors can either invest a lump sum or make monthly payments at very low rates of commission. A disadvantage is that most managers only offer this facility once a month, and not always on their full range of investment trusts.

## 6. Charges

The costs associated with acquiring investment trust shares are lower than those of unit trusts. Unit trust managers set an initial charge of either 5 or 5.25 percent when units are bought[18]. However, the bid/offer spread is often larger than that. The calculation is strictly controlled by the Department of Trade and Industry (DTI), and in theory can go as high as 12 percent[19]. In the case of investment trusts, there is no initial management charge when shares are bought and the bid/offer spread is normally around 2 percent. The dealing costs involved in buying or selling through the investment trust management company can be as low as 0.2 percent, whereas a stockbroker normally charges 1.65 percent[20]. On a purchase there is also a stamp duty of 0.5 percent. Considering the management charges and bid/offer spread as a whole, the cost associated with buying and selling investment trust shares can be less than 4 percent of the original investment, and never above 8 percent. With unit trusts[21], the equivalent costs can be as high as 13 percent[22].

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[18] The annual charge will be deducted before the investment income is distributed to unitholders, but the initial charge will normally be part of the buying price.

[19] The published spread is normally between 5 and 7 percent, but the managers are free to fix their prices anywhere within the permitted spread. An investor might have to buy the units when prices are being fixed in relation to the offer price, and sell them when they are being fixed on the bid - the spread can in theory become as high as 12 percent. On the other hand, if the investor buys the units when prices are being fixed in relation to the bid price and sell them when they are being fixed at the offer, the spread can in theory disappear.

Unit trust managers take a stated fee for managing unitholders' money. All saving measures that they achieve will increase their own profit. Conversely, it costs the unitholder no more if a trust is managed expensively, but the management organisation suffers financially. When an investment trust is able to save money, any savings are usually for the benefit of its shareholders.

## 7. Promotion

Investment trusts are not allowed to advertise as readily as unit trusts There are strict legal rules governing the promotion of company shares which apply to all companies including investment trusts[23]. Companies are not permitted to promote their own shares unless they produce a full-scale prospectus, and clearly no investment trust can afford to do this each time it wants to promote itself. This is one of the major reasons why investment trusts may be neglected by the investment community. The problem has been reduced by the introduction, in 1984, of investment trust savings schemes,

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[20] Stockbrokers usually have minimum charges of £25 or more, which increases the costs of small transactions.

[21] In the US, some open-end companies, known as no-load funds, sell their shares by mail to the investors. Since no salesperson is involved, there is no sales commission (load) and the shares are sold at the Net Asset Price. Others, known as load-funds, offer shares through brokers or other selling organisations, which add a percentage load charge to the Net Asset Value, and a portion of the investor's equity is removed as the "load" at the beginning of the contract. The load charge is generally about 8 percent of the sale price. It is possible, but much less usual to buy units directly from existing unitholders. In the US, the term "Unit Trust" is used in a more limited sense to refer to a fixed unit trust, a company with a portfolio that is fixed for the life of the fund.

[22] Recently, the UK has turned to no-load unit trusts (e.g. Virgin and Legal & General index funds). Typically the bid/offer spread of no-load funds is 0.7 percent and if the fund is expanding, there is single pricing. For some no-load trusts there are back-end fees, but they usually decrease the longer you hold onto the units (e.g. M&G: the back-end fees are 5 percent if you sell the units within 1 year, 4 percent if you sell them within 2 years etc.. and there are no back-end fees after 5 years).

[23] The promotion of investment trusts is restricted by the Prevention of Fraud Act as an advertisement stimulates demand but the supply of shares by the fund is fixed.

which have been actively promoted by certain management groups. But even these schemes cannot be advertised as aggressively as unit trusts.

## 8. Life of a fund

Investment trust companies do not usually have a fixed life. They stay in existence until there is a liquidation, merger, takeover or conversion into a unit trust. Exceptions to this general rule are the split-level trusts, which usually have a life fixed at the time of formation, and the companies formed with a limited life[24]. Unit trusts have a stated life, but most trust deeds are often drawn up in such a way as to require positive action by the unitholders to terminate the trust.

## 9. Freedom to invest

Investment trusts must derive most of their income from shares or securities. Beyond that they are relatively free in the choice of investment. Unit trust are governed by their trust deed, which lays down very specific guidelines for investment management. They are restricted to investments in securities quoted on recognised stock exchanges and there are strict limitations on the proportions that may be invested in unlisted securities. Unit trusts' freedom to invest is reduced by further restrictions - they must maintain a minimum level of diversification and no single investment can account for more than 7.5 percent of any unit trust, or more than 10 percent of any one class of share. This contrasts with investment trusts, which can invest up to 15 percent of their assets in any one security, except for unit trusts.

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[24] Limited-life trusts, introduced at the end of the 1970s, have a provision requiring shareholders to vote at regular intervals on a resolution instructing the board to wind-up the company. The idea is to limit the discount to NAV. If the discount gets too large, shareholders have the opportunity to wind-up the fund - they are repaid at NAV but bear the risk of not being able to realise the full value of the portfolio. Limited life imposes investment inhibitions, particularly with regard to new borrowings and to less marketable and unlisted securities. In 1997, approximately 40 percent of investment trusts had a wind-up option.

## 10. Taxation

The investment revenue account must be divided into two streams: franked and unfranked income. The franked stream consists of income net of UK corporation tax - ordinary and preference dividends received from companies in the UK. The franked stream, while not taxable, is shown gross in the accounts of a trust, with a provision made for the amount of tax credit on the dividend received by the trust. If the franked income is greater than the dividends the trust 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 investment trust[25]. Unit trust are not usually subject to corporation tax.

Investment trusts cannot retain more than 15 percent of dividends received. 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. Investment trusts are not allowed to distribute capital gains, but must retain them for reinvestment[26]. Capital Gains Tax on investment trusts was reduced to 10 percent in

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[25] It is theoretically possible for an investment trust company to have no UK tax liability on its revenues. If all the franked stream is paid out in dividends, the tax credit attached to the dividend income received will exactly match the tax credits attributable to the dividends paid. Furthermore in the unfranked stream, it is possible to construct a UK tax liability that exactly matches the withholding tax on foreign dividends. Nevertheless, it would probably be a poor investment policy for an investment trust to regard tax avoidance as essential rather than desirable.

[26] Under the US tax system, closed-end funds are required to distribute to shareholders 90% of realised 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 will be 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 long-term capital gains rate. Before 1986, the capital gains rate was lower than the highest tax rate on ordinary income. The 1986 Tax Reform eliminated the favourable tax treatment on capital gains by making capital gains income taxable as ordinary income. In addition, there was no longer a difference between long- and short-term capital gains tax rates. Federal regulations require closed-end funds that elect to retain their beneficial tax status to return all dividend income to shareholders every year. Closed-end funds typically pay

1977 and removed completely in 1980. Therefore, investment trust managers can turn over their portfolios without incurring any Capital Gains Tax liability[27].

Investment trust shareholders and unitholders are liable to capital gains tax in exactly the same way as for any other investment[28]. However, many investors need never pay the tax. All capital gains are now inflation adjusted[29] and there is an annual capital gains tax exemption - £6,300 for the 1996/97 tax year (the threshold in increased to £6,500 for 1997/98). The UK taxation treatment of dividend and interest distributed by investment trusts is exactly the same as that for an equivalent holding in any other type of company[30]. Shareholders receive dividends net of basic rate tax with a tax credit to cover the amount of tax deducted[31] and debtholders receive interest less income tax at the basic rate.

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dividends quarterly or semi-annually. The US taxation of income received from UK investment trusts is complicated by the different regulations on capital gains. US investors are subject to capital gains dividend tax related to the capital gains realised within the investment trust, despite the fact that they do not receive such income as UK trusts are not allowed to distribute capital gains.

[27] British closed-end funds have never distributed capital gains, but from 1965 to 1980, they were directly subject to Capital Gains Tax. Thus realisation of accrued capital gains had an adverse effect on the NAV. Unlike the case in the US, this also affected zero-tax bracket shareholders such as pension funds who collectively hold a substantial proportion of investment trusts' shares.

[28] Capital gains are taxed at the investor's marginal rate of income tax - 20 percent, 24 percent (23 percent in 1997/98) or 40 percent

[29] The Inland Revenue has published monthly indexation tables, based on the Retail Price Index, since March 1982 - they indicate the amount of gains permitted without incurring Capital Gains Tax. For indexation purposes, shares bought before March 1982 are treated as if they had been bought at that time.

[30] The March 1988 Budget eliminated the differential taxing of capital gains and income.

[31] When a company makes a distribution, it is required to make a payment of advance corporation tax (ACT). As from April 6, 1994 the tax amounts to 20/80 of the distribution - i.e. 20 percent of the sum of the dividend and the tax. The ACT paid can be offset against the ultimate corporation tax liability on profits for the same accounting period, but the amount set cannot exceed 20 percent of taxable profits. Any ACT unrelieved can be carried back six years or forward indefinitely, or it can be surrendered to a subsidiary company. Income from share dividends is taxed at the basic rate of 20 percent and a higher rate of 40 percent. Resident shareholders are entitled to a tax credit on distributions received, which as from April 6, 1994 is equivalent to the ACT paid by the company - a rate of ACT relief of 20 percent, reduced from 25 percent. As with the dividend from any other UK

## 11. Saving Schemes and Personal Equity Plans

For the small private investor the most important innovation has been the introduction of investment trust savings schemes in 1984. The schemes are very similar to the regular savings schemes offered by most unit trusts. They allow a lump sum investment - the minimum is usually as low as £250 - or a regular amount each month - the minimum is usually £25 - in the investment trust of your choice at a very low rate of commission. The only disadvantage is that, in most savings schemes, money can be invested only once a month[32], but by pooling all the purchases and putting a bulk order through one stockbroker, the investment trust manager can negotiate very low rates of commission. Regular savings have the additional feature of pound-cost averaging - more shares are bought for the same cash investment when share prices are lower.

Personal Equity Plans (PEPs) were introduced by the Government in 1986 to encourage private individuals to invest in the UK stock market. The attraction of a PEP is that all dividend income and capital gains from a PEP investment are entirely free of tax[33]. The maximum amount that may be invested in a general PEP is £6,000 in each tax year. As a result of the changes in the March 1992 Budget, it became possible to invest the whole of this amount in a qualifying investment trust. Nevertheless, PEPs can be costly to manage and they are of particular interest to higher rate taxpayers.

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company, the total amount of the dividend and the credit is included in the shareholder's income for tax purposes. The tax credit covers basic-rate tax only, so higher taxpayers have to pay a further 20 percent. Non-tax payers can reclaim the tax credit on dividends. The 1997 Budget Reform announced that, taking effect in April 1999, the tax credit would be further reduced from 20 to 10 percent and that repayable tax credits would disappear almost entirely.

[32] Regular monthly payments and lump sums are invested on a particular day of the month. Larger lump sums (usually above £1,000) are invested the first day after they are cleared.

[33] Every PEP receives income from its investments net of basic-rate tax. The Government permits reclaim of this tax and the amount is reinvested in the PEP.

However, the scenario is due to change after the launch of the new Individual Savings Accounts (ISAs) in April 1999, which are to replace the PEPs. PEPs will lose their tax-free investment status - the tax on dividends reclaim will be removed - and PEP investors will be able to transfer their PEPs into the ISA within the overall investment limit. The Consultative Document of the Inland Revenue (December 1997) describes the proposal for the new Individual Savings Account[34].

## 12. Open-Ended Investment Companies

The open-ended investment companies (OEICS), introduced at the beginning of 1997, are a hybrid between unit trusts and investments trusts. This new type of fund is already common in other European countries such as Ireland and Luxembourg.

Unlike investment trusts, their structure ensures that they can consistently trade at a price which is equal to the value of the underlying portfolio, the NAV. The manager issues shares (and redeems them) at this value. OEICS are open-ended vehicles (the size of the fund is constantly expanding or contracting) and are regulated according to the rules laid down by the SIB and other regulating organisations. Unlike most unit trusts, OEICS are 'single-priced' - buyers and sellers deal at the same price, there is no bid/offer spread. OEICS are companies and are not overseen by trustees charged with representing investors' interests. Instead, an independent depositary, usually a bank, represents the interest of shareholders. OEICS have boards, though potentially not as independent as those that run investment trusts. Their shares may optionally be listed on the stock exchange.

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[34] The Government's proposal for the new Individual Savings Account is: (i) investors will be able to invest up to an annual limit of £5,000. The overall limit of £50,000, suggested when the ISAs were announced, is expected to be abandoned, (ii) as in the case of a PEP, investors will be entitled to exemption from income and capital gains tax on their investments. In addition, a 10 percent tax credit will be paid on dividends from UK equities within the account for the first 5 years of the scheme, (iii) withdrawals may be made from the account at any time without loss of tax relief.

The OEICS have been introduced mainly because, unlike investment and unit trusts, they can be sold to investors all over Europe. This new type of fund has also some advantages for investors - they offer different classes of shares, typically in different currencies and make it easier and cheaper for investors to switch between sub-funds grouped under one umbrella.

## 13. Conclusion

Closed-end funds have existed in the UK as a distinct category for more than a century. Over time the number of investment trust companies has gradually increased, albeit with some setbacks. The 1980s witnessed a period of unprecedented innovation. A wide range of new funds came into existence, covering different investment objectives, geographical regions and capital structures. At the same time, the regulatory environment became increasingly complex. There is a greater need than ever before to have a clear, research based, understanding of the functioning of the investment trust industry.

# Chapter 3

## The Closed-End Fund Puzzle: a Literature Review[35]

### 1. Introduction

Closed-end funds, referred to in the UK as investment trusts, are characterised by one of the most puzzling anomalies in finance: the closed-end fund discount. Empirical research has shown that shares in US funds are issued at up to a 10 percent premium to net asset value (NAV). This premium represents the underwriting fees and start-up costs. Subsequently, within a matter of months, the shares trade at a discount[36], 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)). 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 the aforementioned peculiarities. Agency costs, such as managerial performance and the present value of management fees, cannot account for the fluctuations in discount.

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[35] 'The Closed-End Fund Puzzle: A Literature Review' to be published in "Security Market Imperfections in World Wide Equity Markets", Cambridge University Press, 1998 (forthcoming), eds. W.T. Ziemba and D.M. Keim.

[36] For a sample of 64 closed-end funds that went public from 1985-1987, Weiss (1989) shows that within 24 weeks of trading, US stock funds trade at a significant average discount of 10 percent. The cumulative index-adjusted return reaches -23.2 percent after 120 days.

Similarly, the assertion that NAVs are incorrectly calculated (as a result of letter stocks and tax liabilities relating to unrealised capital gains) cannot explain the price rise at open-ending. Additionally, some published studies have shown that discount based trading strategies can prove profitable when high discount shares are bought and low discount shares are sold (Thompson (1978), Pontiff (1995)). Thus the issue of closed-end fund shares may well represent a possible violation of the efficient market hypothesis.

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), affected by the same investor sentiment. However, the limited-rationality theory is inconsistent with empirical evidence of the UK closed-end fund market largely dominated by institutional ownership. This chapter reviews most of the theories attempting to explain the existence and behaviour of the discount on closed-end funds.

## 2. Theoretical Principles and Performance of Closed-End Fund Shares

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 existence of agency costs, tax liabilities and illiquid assets have been put forward as possible explanations for the discount, but none of these, even when considered together, can account for the closed-end fund anomaly.

## 2.1. Agency costs

Agency costs - management fees and management performance - are a possible explanation of the closed-end fund discount if expenses are considered too high or if future portfolio management is expected to be below par. There are, however, several problems with this theory. Positive agency costs imply that funds should never be issued at a premium as long as no-load open-end funds[37] charging comparable fees exist. Furthermore, the agency costs theory neither accounts 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 theory 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.

### 2.1.1. Management fees

The agency costs theory claims that the discount on closed-end funds is 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[38]. 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 changes in the term structure.

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[37] Open-end funds, referred to in the UK as unit trusts, are characterized by the continual selling and redeeming of their units at or near NAV and this at the request of any unitholder. Therefore, these trusts have a variable capitalisation. The open-end fund units not being traded implies that their managers are not priced by the market. In the US, some open-end companies, known as no-load funds, sell their shares by mail. Since no salesperson is involved, there is no sales commission (load) and the shares are sold at NAV.

[38] Turnover is also suggested as a possible explanation for the discount. While limited portfolio reallocations may be required to maintain diversification, some closed-end fund managers do a large amount of unnecessary portfolio shifting. Malkiel (1977) finds no correlation between discounts and turnover.

Ammer (1990) shows, with both a simplified static and dynamic version of a new analytical arbitrage based framework, that expenses and yields account for a level of the discount that is typical of UK investment trusts. 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. Using a larger sample and a different specification of the expense variable from the one used by Malkiel (1977), they find that discounts are related to expenses[39].

### 2.1.2. Management performance

The agency cost theory predicts that if the fund pays more than the 'fair value' for managerial expertise, its shares should sell at a discount or earn an abnormally low return on investment, and vice versa. 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[40]. This we shall term the performance theory of closed-end fund discounts.

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[39] Malkiel (1977) defines the expense variable using: $EXP1_t = expenses_t / NAV_t$. Kumar and Noronha (1992) propose the alternative specification: $EXP2_t = expenses_t / (dividends_t + expenses_t)$

[40] The two-factor CAPM is an asset pricing model which implies that, in equilibrium, the expected return on an asset is

$E(r_j) - E(r_z) + \beta_j \{E(r_M) - E(r_z)\}$ where

$E(r_j)$ = expected return on asset $j$
$E(r_z)$ = expected return on a security that has zero-beta with the market (which is riskless in the portfolio $M$)
$E(r_M)$ = expected return on the market portfolio
$\beta_j$ = systematic risk, $Cov(r_j, r_M) / Var(r_M)$

Thompson (1978) estimates the systematic risk, $b_j$, regressing past asset returns on past market returns. The benchmark returns are taken to be those given by the restricted borrowing and lending CAPM and defined as

$\hat{r}_{j,t} = d_{o,t} + d_{1,t} b_{j,t}$

Agency costs do not seem to explain much of the cross-sectional variation in the discount. Malkiel (1977) finds no significant relationship between future fund performance and discount levels[41]. Roenfeldt and Tuttle (1973) find, in a very small sample, marginal support for a contemporaneous relationship. Assuming rational expectations, the performance theory predicts that large discounts reflect poor future NAV performance. However, Lee, Shleifer, and Thaler (1990) do not support the 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 the net managerial performance[42], shows that funds selling at discounts underperform funds selling at premiums. Thus, his findings tend to support the hypothesis that discounts reflect market expectations of fund manager future performance. However, in Chapter 5 we show that also using a definition of managerial performance that adjusts for the fund's effective asset exposure, discounts do not seem to reflect 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

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where $d_o$, $d_1$ are market determined parameters which describe ex-post the average relationship between systematic risk and realised returns. The values are taken from Fama and MacBeth (1973). The residuals are

$$\hat{e}_{j,t} = r_{j,t} - (d_{o,t} + d_{1,t} b_{j,t})$$

and the time series average of the $e$ is the estimated $\alpha$, the abnormal performance.

[41] Malkiel assumes that either short- or long-run past performance might serve as a useful proxy for expected future performance. In order to measure the performance of managers NAVs are used rather than market prices of the fund shares. The intercept $\alpha$ from the Ordinary Least Squares regression of excess returns is used as a measure of risk-adjusted performance;

$$r_{j,t} - r_F = \alpha + \beta (r_{m,t} - r_F)$$

[42] Chay defines 'Net managerial performance' as gross managerial performance less expenses charged by managers.

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[43].

### 2.1.3. Agency problems

Agency theory focuses on the relationship between the principal (the shareholder of the trust) 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 finds that UK investment trusts are rarely managed ‘in-house’ but rather contract out their management to groups of specialists. These 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 data supports this hypothesis[44]. Evidence from the UK is less satisfactory. The very low levels of liquidation and open-ending costs revealed by Draper’s study suggest that far more trusts could profitably have been liquidated with beneficial effects for the shareholders of the trust. However, he also shows that investment trust managers receive considerably higher fees on open-ending and consequently it would be in their interest to open-end.

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[43] The Japan Fund Inc., the first major US fund to invest in Japan, traded as a closed-end fund until August 14, 1987 when it was open ended. From the beginning of 1986 to the end of 1987, the shareholders earned 188 percent return, which includes the 19 October 1987 crash (Ziemba and Schwartz (1992)).

[44] Informal discussions with US closed-end fund managers revealed the existence of attempts to resist any open-ending pressure from the shareholders.

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 veto open-ending proposals to preserve these benefits.

## 2.2. Miscalculation of NAV

Explanations of the discount, consistent with market efficiency and frictionless capital markets, emphasise the notion that NAV may be overestimated. Tax liabilities relating to unrealised capital gains and restricted stocks are considered as possible causes of this miscalculation. However, this theory is neither consistent with the existence of premiums to NAV nor with the empirical regularity of price rises at 'open-ending'[45].

### 2.2.1. Tax liabilities related to unrealised capital appreciation

In the US the regulations governing closed-end funds and the tax system are such that the funds must distribute 90 percent of realised gains to qualify for exclusion from corporation tax. Therefore, shareholders receive two streams of dividends: the income dividend and the capital gains dividend. If a closed-end fund is characterised by large unrealised capital gains, this implies that shareholders will be liable for capital gains taxes and the theory suggests that this might explain part of the discount on closed-end funds[46]. However, Malkiel (1977) finds, under fairly generous assumptions, that tax liabilities can account for a discount of no more than 6 percent. 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. In Chapter 8 we confirm this pattern for the UK market.

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[45] The term "open-ending" (referred to in the UK as "unitisation") refers to a set of techniques that force a closed-end fund's share price to NAV: converting the fund to an open-ended fund, merging the fund with an open-ended fund, and liquidating the fund's assets and distributing the proceeds to the shareholders.

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 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 unrealised capital gains, and the discount should in general widen, if turnover rates on fund assets are constant. However, Lee, Shleifer and Thaler (1991) find that the correlation between returns on the market and changes in discounts is about zero.

### 2.2.2. Restricted shares

Bookkeeping procedures can potentially lead to a fund manager either under- or overestimating the fund's NAV. Reporting restricted shares[47] (letter stocks) 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 of the funds hold little letter stock and 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, evidence shows that the share price in fact rises.

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[46] However, UK regulations are different. The trusts are not allowed to distribute any capital gains and the shareholder's revenue is the income dividend with a tax credit attached. Unless they sell their shares, they will not be liable to any capital gains tax.

[47] 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.

### 2.2.3. Liquidity

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 to determine their fair market value. The importance of liquidity in terms of explaining stock returns is demonstrated by Datar, Naik and Radcliffe (1993). The liquidity argument is a possible explanation for the discounts. However, investors might be willing to pay higher management fees for holding the liquid shares of investment trusts that invest in less liquid securities, such as small capitalisation stocks. Therefore, the importance of illiquid assets is difficult to measure.

## 2.3. Other possible explanations for the discount

### 2.3.1. Sales effort

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 different securities from closed-end fund shares because of lower commissions on the former[48]. Furthermore,

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[48] Malkiel argues that 'investors usually do not buy investment funds', but it is the public who is sold fund shares by brokers or other salesmen.

Anderson (1984) shows that after the reduction of commission fees in 1975, which in all probability reduced sales efforts, US discounts increased.

### 2.3.2. Holdings of foreign stocks

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 price to NAV ratios. Using weekly data from 1981 to 1989, they find that four out of five country funds examined 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 levels above 100 percent. Furthermore, Malkiel (1977) finds no significant relationship between discounts and holdings of foreign stocks[49].

## 3. Tax-Timing Option Values

A number of papers have attempted to justify the discount of investment trusts by the effect of the tax liabilities associated with unrealised capital gains. But, Tax Code legislation may have an additional implication related to the tax-timing argument. Constantinides (1983, 1984) investigates the influence of taxes on security returns. The ownership of 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-trading strategy is to realise 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 flexible than an option on the corresponding portfolio.

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[49] As an interesting aside, 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) findings that these funds are poor substitutes for direct holdings of foreign securities. However, Chang et al. 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.

## 3.1. Models

Brickley, Manaster and Schallheim (1991) and Chang-Soo 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 investment trust discount is partly driven by the fact 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. Brickley et al. (1991) 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[50].

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[51] and that funds with more volatile securities will show greater discounts than funds with less volatile securities in their portfolios[52].

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[50] 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 the variances of stocks tend to increase during business downturns.

[51] 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

## 3.2. Empirical evidence

Evidence from the US closed-end fund market tend to support the tax-timing option argument. The 1986 Tax Reform 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'[53] 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.[54] However, De Long, Bradford and Shleifer (1992) show that the discount on US closed-end funds progressively widened between 1985 and 1990. The UK investment trust market does not provide much stronger evidence supporting the tax-timing argument. The 'restart option' was effectively[55] eliminated in 1985 and the average discount progressively narrowed from 20 percent in 1985 to 5 percent in 1990. However, 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.

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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.

[52] Brickley et al. (1991) find a similar result. However, they do not consider correlations between assets.

[53] 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 realise long term gains in high variance stocks in order to realise potential future losses short term.

[54] In March 1983, 45 closed-end funds operated in the US, with total assets of $6.9 billion. In 1991, the number had jumped to 270, with total assets of $60 billion. Kim (1994) tests the hypothesis that the average number of closed-end funds before 1986 is equal to the average number after 1986. The means are respectively 55.2 and 152.7. The hypothesis of equal means is rejected.

[55] 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.

The tax-timing option and investor sentiment explanations are not mutually exclusive and both factors may contribute to the discount. The investor sentiment hypothesis does not appear to explain the cross-sectional findings that relate the discount to the variance of constituent assets within a given year. Additionally, however, the tax-timing hypothesis cannot account for funds selling at a premium[56]. 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 Personal Equity Plan, is particularly interesting because it allows the tax-timing argument to be consistent with both premiums and discounts to NAV.

### 3.3. Relevance of the tax-timing option

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 continually adjust their portfolios to minimise the present value of their net tax payments.

## 4. Limited Rationality - Investor Sentiment

The failure of the standard theories to explain the anomalous behaviour of the discount on closed-end funds casts doubts 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 behaviour 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 was attributed to speculations about investment opportunities in Germany. For a long time after this episode, the Germany fund traded at a premium. What made the behaviour 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).

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[56] The tax option argument fails to account for the coexistence of open-end and closed-end funds, as the former are equally subject to the tax-timing option penalty, but sell at NAV.

Zweig (1973) is the first to have suggested that discounts might reflect the expectations of *individual* investors. Weiss (1989)[57] supports this conjecture and shows that individual investors, as opposed to institutional investors, own a larger stake in closed-end funds. Lee, Shleifer, and Thaler (1991) build on this evidence and speculate that the discount movements reflect the differential sentiment of individual 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.

## 4.1. Investor sentiment model

De Long, Shleifer, Summers, 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 traders, an argument clearly inconsistent with the efficient market hypothesis.

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[57] 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 21.82 percent and 3.50

The argument is that discounts on closed-end funds reflect changes in investor sentiment rather than changes in each fund 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 at equilibrium because the fluctuations in the same noise trader sentiment affect many assets and are correlated across noise traders, which implies that the risk that these fluctuations create cannot be diversified. As a result, assets subject to noise trader risk will earn a higher expected return than assets not subjected to such risk. Therefore, relative to their fundamental values, these assets will be underpriced. The returns earned by Thompson's (1978) portfolio strategies are earned at the expense of being exposed to the investor sentiment. Pontiff (1995) provides weak evidence supporting the hypothesis that funds with larger discounts are exposed to greater investor sentiment risk.

The implications derived from the investor sentiment theory are supported by US empirical findings: discounts on various funds move together,[58] new funds get started

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percent after the first quarter following the offering (the disparity of levels persists throughout the first three quarters).

[58] Lee, Shleifer, Thaler (1991) show that the average pairwise correlation of annual changes in discounts among domestic stock funds is 0.389 over the period 1965-1985.

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when seasoned funds sell at a premium or at a small discount[59], and discounts are correlated with prices of other securities, such as small stocks, that are affected by the same investor sentiment. Furthermore, Weiss and Seyhun's (1994) show that, because of the possibility of shifts in investor sentiment[60], short sellers earn significant abnormal returns only during the IPO period where price declines are fairly certain.

### 4.2. Discount and small firms effect

Evidence of individual investors specialising in holding small stocks justifies the Lee, Shleifer and Thaler (1991) conjecture that the investor clientele argument explains both the behaviour of the discount on closed-end funds and the 'small stock effect'[61]. Their results support the theory because discounts tend to narrow when small stocks perform well and vice versa. However, Chen, Kan and Miller (1993) challenge the sentiment theory by questioning the link between discounts and 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[62]. 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 "fundamental" APT factors[63].

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[59] Levis and Thomas (1994) show that UK investment trust IPOs are subject to 'hot' issue periods, implying that they tend to occur when there is a marked narrowing in the discounts of seasoned trusts.

[60] The shift is most noticeable in the case of the Spain fund in September 1987 when many short sellers lost money because they were caught in a 'short squeeze' and were unable to obtain additional shares after being forced to close their positions. A 'short squeeze' occurs when shorted shares are called back from the short seller by the owner's broker.

[61] Small capitalisation stocks are shown to earn returns different from large capitalisation stocks.

[62] In their regression for the critical small-firm size group of decile 1, Chopra, Lee, Shleifer, and Thaler (1993) report a R-squared of 3.5 percent - smaller than the upper bound of 4 percent determined by Chen, Kan and Miller. However, they claim that the low $R^2$ is misleading because the dependent variable is effectively a change in the discount, which is purged of marker return, while the independent variable, decile 1, contains the market return. Correcting for this bias the $R^2$ rise to 6.9 percent.

The investor sentiment and this contemporaneous correlation between closed-end fund discounts and small firm returns have been further investigated by Swaminathan (1994a)[64]. He recognises that any (mean-reverting) small investor sentiment should not only affect current stock prices but also forecast future stock returns.[65] 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 and that their forecasting power is independent of the movements tracked by other forecasting variables, such as the dividend yield, the default spread and the term spread[66].

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[63] Lee et al. show that the five 'fundamental' factors used by Chen, Roll and Ross together explain 12.5 percent of time series variation in small firm monthly excess returns. Adding the change in the value-weighted discount increases $R^2$ to 17.9 percent.

[64] Swaminathan (1994b) develops a noisy *rational* expectations model of closed-end fund discounts with perfectly informed large investors and imperfectly informed small investors.

[65] This is strictly true only if the small investor sentiment is stationary and mean-reverting. However, it is hard to imagine a sentiment that is non-stationary and yet behaves, for instance, like a random walk.

[66] 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 rates.

Barber (1994) provides further evidence which supports the investor sentiment hypothesis. He documents several empirical facts which are consistent with the hypothesis that noise trading drives the time-series variation of the premium of Primes and Scores[67]. Barber (1994) shows that Primes and Scores are predominantly traded by individual investors, that the levels and changes of their premiums are correlated across trusts 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. However, during 1995-96 US small stocks did well while discounts remained high.

### 4.3. Discount and 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[68] from open-end funds, although the regression coefficient was not significant. This suggests that open-end fund investors, which are mainly individuals, are affected by the same investor sentiment. Furthermore, discounts do not seem to be highly correlated with measures of fundamental risk,[69] which implies that this sentiment index is not a proxy for macroeconomics factors previously identified in the literature.

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[67] Primes and Scores are derivative securities created by Americus Trust. Americus offered investors the opportunity to tender common stock of select DOW 30 companies in exchange for a Prime and a Score. A Prime entitles an investor to all cash distributions on the stock and a pre-set capita gains portion, fixed by a termination claim. A Score entitles an investor to the stock's capital appreciation above the specified termination claim. 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.

[68] Net redemption is defined as the number of units redeemed in excess of the number of new units issued.

[69] Chen, Roll and Ross (1986) present a number of macroeconomics variables that affect stock returns in time-series regressions and expected returns in cross-section regressions. They interpret the variables to be risk factors. The variables include 'innovation' in: industrial production, risk premia on bonds, the term structure of interest rates, and expected inflation.

### 4.4. The marketing of closed-end funds

The fact that closed-end funds are characterised by a substantial price decline after the floatation cannot explain the behaviour of investors who buy in the first place. Weiss Hanley, Lee and Seguin (1995) attempt to explain this anomaly examining the aftermarket transactions for closed-end fund IPOs. They show that most closed-end fund trading in the first weeks is seller-initiated[70], 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.

### 4.5. Investor sentiment in the international markets

Lee, Shleifer and Thaler (1991) speculate that the discount movements reflect individual investors' sentiment. However, using closed-end funds whose NAV are determined in the same market as the 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 et al. 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 behaviour 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 world-wide and American stock returns, and not to changes in individual countries.

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[70] Short-selling is not allowed during the first weeks of trading. Therefore, Weiss et al. relate this selling pressure with the presence of "flippers" - investors who buy IPO shares during the pre-issue period and immediately resell them in the aftermarket.

## 4. 6. Limits to the investor sentiment hypothesis

The investor sentiment hypothesis provides an interesting explanation of the four-part 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 discounts.

Even more contradictory is Ammer's (1990) evidence. The limited rationality theory is grounded on the evidence that individual investors own the largest stake of US closed-end funds. However, despite the fact that British investment trusts go through periods of discount and premium similar in most respect to US funds[71], their clientele is, and has been over the last decade, almost entirely institutional (70 to 75 percent in 1990)[72]. Despite this inconsistency, Levis and Thomas (1995) show that UK closed-end fund IPOs are subject to 'hot' issue periods - IPOs tend to occur when there is a marked narrowing in the discounts of seasoned trusts - which is related to the implications of the De Long et al (1990) noise trader model. 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. Larger institutional ownership in the UK is suggested as a possible explanation.

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[71] The characteristics of UK fund discounts are very similar to those reported for American data, although discounts have been generally larger in the UK.

[72] The 1989-1990 Warburg Securities Investment Trust Manual reports that only 7 out of 102 funds have more than 50 percent 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 the empirical results documented by Lee, Shleifer and Thaler (1991).

## 5. The Efficiency of the Closed-End Fund Market

Several US 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 that the existence and behaviour of discounts is evidence of persistent mispricing of assets resulting from market inefficiencies[73]. With respect to open-ending, the behaviour of closed-end funds is generally rational and the market for closed-end fund shares seems efficient. If these traits characterise closed-end funds in general, then the persistent discounts at which most funds sell must have a rational explanation in an efficient market.

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 portfolio. But the costs of only partial proceeds from a short sale and the risk of an increase in the discount result in a loss to an investor with a short horizon. A possible alternative to 'buy and hold' arbitrage for eliminating the discount is taking over the fund. However, this approach would tend to be resisted by fund managers and shareholders have an incentive not to tender unless the bid is at NAV (Grossman and Hart (1980)), which would leave no profit for the bidder.

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[73] In most cases tests of market inefficiency are tests of the joint hypothesis; market inefficiency (generally referring to semi-strong form of efficiency), and two-parameter equilibrium model of asset pricing

### 5.1. Inefficiency

Several studies have tested various strategies for investing in closed-end funds using buy-and-hold rules, filter rules, rules based on 'open-ending' information, and rules exploiting discounts and expenses data. Often these rules appear to generate abnormal returns and, therefore, contradict the efficient market hypothesis. However, the contribution of mismeasured normal return benchmarks to such results is still unclear.

#### 5.1.1. Abnormal returns

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, abnormal risk-adjusted return of about 4 percent. These results suggest that high discounts tend to represent some sort of underpricing and that the market is inefficient as it does not recognise this[74]. Thompson is careful to emphasise that it is not possible to identify the extent to which his result reflect capital market inefficiency as opposed to deficiencies in the method of adjusting prices for risk,[75] but confirmatory evidence from an earlier study by Zweig(1973) suggests a very real inefficiency[76]. Furthermore, Anderson (1986) reports evidence that abnormal returns could be earned by the use of filter rules involving the purchase of the shares of US closed-end funds of which the discount had widened and the sale of the shares of those companies of which the discounts had narrowed.

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

[75] 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.

[76] Zweig demonstrates the existence of sufficient forecasting properties in the investor's expectations.

Evidence from UK investment trusts is both less comprehensive and less compelling. The investment performance study of Guy (1978) suggests that trusts do not outperform the market after suitable allowance for risk. However, Cheng, Copeland, O'Hanlon (1994) test for evidence that abnormal returns can be earned by holding investment trust 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 investment trusts and replacing it by high discount investment trusts[77]. The availability of such returns suggests the possibility of market inefficiency. The paper identifies positive and negative abnormal returns as being associated respectively with high and low discount investment trusts. Cheng et al. confirm Brickley, Manaster and Schallheim's (1991) finding that US discounts tend to narrow as the market rises and widen as it declines[78]. This empirical regularity might suggest the existence of some overreaction in the pricing of investment trust shares.

### 5.1.2. Abnormal returns during the reorganisation of the funds

A number of papers document the earning of positive abnormal returns by the holders of US closed-end funds which reorganise 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 reorganised. 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 return are small. The existence of abnormal returns after the announcement of 'open-ending' is inconsistent with the joint hypothesis of market efficiency and that 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. Consequently, the market prices these risks to yield higher expected returns than those given by the benchmark. The initial response to the announcement suggests that investors in closed-end funds are rational and awake to profit opportunities. Despite the evidence, neither study is able to determine whether the closed-end fund market is really inefficient or the market model is not the appropriate benchmark.

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[77] Returns are computed using monthly prices of investment trust shares, without adjusting for the bid-offer spread. However, the typical spread on UK investment trusts is lower than 2 percent.

[78] Brauer and Chang (1990) show that US closed-end funds display the typical size-related January effect, while their NAVs do not. The return of large fund share portfolios over the first four weeks of

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 earn returns exceeding those predicted by the two-factor capital asset pricing model as well as those earned by a discount-only strategy investigated by Thompson (1988).

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the year exceeds the average four-week rate of return over the rest of the year by 3.41 percent. Portfolios of small fund shares earn almost twice this differential, 6.67 percent.

### 5.1.3. Predictability

Fraser and Power (1991) find significant autocorrelation in the excess returns of UK investment trust fund shares, which tend to suggest the predictability of these returns[79]. Pontiff (1995) provides further evidence showing that US discounts have an economically strong ability to predict returns. However, this relationship remains puzzling and 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 discount-mean reversion, not to anticipated future performance. He finds that funds with 20 percent discount have expected 12-month returns that are 6 percent greater than non discounted funds.

### 5.1.4. Over-supply argument

An additional explanation for the inefficiencies in the UK investment trust market is the over-supply argument suggested by Arnaud (1983). He argues that the market is segmented and dominated by institutions that distort the prices[80]. 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 the investment trust shares but can, to a large extent, influence the price in terms of the discount at which they are willing to buy.

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[79] Whiting (1984) finds evidence of the ability to trade profitably in UK investment trust shares using models based on discount levels. In forecasting and trading rules tests, the AR(1) model applied to the raw series gives the most consistent improvement upon the random walk model.

[80] The ownership structure of the UK funds has changed considerably over the years. In 1964 individuals held almost 60 percent of the trusts but the stake was not larger than 25 percent in 1984. The increase in the proportion of institutional shareholders - 70 to 75 percent in 1990 - has, however, began to revert and individual investors are now more active, particularly since the introduction of the saving schemes in 1984.

### 5.1.5. Arbitrage

The level of inefficiency in the closed-end fund market can be measured by the presence of arbitrageurs. Weiss (1989) and Peavy (1990) document the gradual decline in the value of the shares over the first 100 trading days. If this gradual decline in value reflects market inefficiency, then investors possibly could take advantage of the mispricing by short selling the securities. Weiss and Seyhun (1994) investigates the profitability of arbitrage and provide evidence of closed-end fund pricing inefficiency during the initial public offering (IPO). They show that short sellers are interested in funds trading at a premium, but their profitability is limited to the first months of the IPO[81] - on average, short sellers earn significant abnormal return of 21 percent after 150 trading days.

Discounts persist because arbitrage[82] is costly and, therefore, not always profitable. Pontiff (1996) identifies factors that influence the arbitrage profitability and shows that cross-sectionally, the magnitude of discounts is most severe in closed-end funds that holds portfolios with high idiosyncratic risk, in funds with the lowest dividend yield[83], and in funds with the highest bid-offer spread. In time series, the average magnitude of discounts is shown to increase when interest rates increases - interest rates being an opportunity cost since arbitrageurs do not enjoy full access to short-sale proceeds.

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[81] 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). Incentives to sell short investment trust IPOs are large, but 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.

[82] If investment trusts trade at a discount to NAV, an apparent arbitrage profit can be realised by shorting the fund's portfolio and holding the fund's shares. However, if the discount stays relatively constant over the investment horizon, the arbitrageurs make no profit. Furthermore, the exact portfolio composition is not known at every instant. In the UK, the Association of Investment Trust Companies (AITC) publishes monthly each fund's exposure, but not the detailed list of all shares held.

[83] 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.

## 5.2. Efficiency

The US evidence indicating the existence of profitable decision rules from investing in closed-end funds, together with a failure to explain the discount, has turned market inefficiency into the only possible explanation for the existence of the discount. Therefore, 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.

### 5.2.1. Price reaction to open-ending announcements

Brauer (1984) investigates the rationality and the informational efficiency of the market for closed-end fund shares in the US by examining 'open-ending' events that force the share price to its NAV. The paper reports that most of the positive abnormal returns associated with open-ending is exhausted by the end of the announcement month. This rapid market reaction suggests that the market for closed-end funds is generally efficient[84].

Draper (1989) investigates the UK investment trust industry and finds that share prices react rapidly to the announcement of takeovers, unitisations and liquidations. He shows that by the end of the announcement month all the information about the unitisation has been incorporated in the price and no significant rise occurs thereafter.[85] The study shows that the adjustments to the announcement of open-ending, as compared to Brauer's (1984) results for US closed-end funds, appear to be more concentrated and completed more rapidly.

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[84] Brauer also reports that high discount companies and companies with low management expense ratios (expense ratios being a proxy for managerial resistance to open-ending) were more likely to open-end.

[85] No statistically significant increase in returns occur after details of the liquidation or unitisation become public. This suggests that investors were able to make accurate estimates of the value of the portfolio.

Draper (1989) provides an additional test of market efficiency comparing investment trust market prices at the time of the announcement of open-ending (liquidating the fund's assets) with the value of the trust's asset at the actual open-ending, adjusting for transaction costs. On average, the difference between the announcement price and the NAV of the liquidated trust was very small. The difference was somewhat larger for the unitisation announcement (transforming the investment trust into a unit trust), but attempts to derive a profitable decision rule were unsuccessful. These results show that investing in unitising trusts from the day of the announcement to the end of the unitisation yielded significant returns only if calculated using simply market prices. Draper demonstrates that considering, instead, asking prices adjusted for transaction costs this would reduce abnormal returns to levels not even approaching those found by Brickely and Schallheim (1985).

## 6. Conclusion

This literature review has attempted to show the breadth of empirical evidence on the closed-end fund puzzle, which has been presented over the last 20 years. Most emphasis has been placed on the behaviour of US funds but some research has centred on experience within 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 parts of the puzzle - investors buy closed-end fund IPO shares despite evidence of a substantial price decline within the first few months, discounts vary cross-sectionally and fluctuate according to a mean-reverting pattern.

Agency costs (management performance and management fees) cannot account for the fluctuations in the discounts. The conjecture that NAVs are undervalued (as a result of letter stocks and tax liabilities related to unrealised capital gains) cannot explain the price rise at open-ending. The tax-timing option hypothesis attempts to explain the closed-end fund discount in terms of the loss of valuable tax-trading opportunities associated with idiosyncratic movements of the individual shares. The theory, however, is inconsistent with evidence that investors' trades are not motivated by tax incentives. 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 behaviour 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 (except during the IPO months when the price decline is substantial).

In the following chapters we have attempted to extend the analysis that, to date, has primarily focused on the US closed-end fund industry. We first revisit one of the traditional theories for explaining the discount - managerial performance. The conjecture that discounts reflect the quality of the management has been investigated in the past but the results were inconclusive. However, they defined managerial performance as the total return on the fund's NAV whereas we introduce a measure of managerial performance that adjusts for the fund's effective asset exposure. Second, we describe the time-series behaviour of UK closed-end funds in terms of autocorrelation, stationarity, mean-reversion and cointegration. Finally, we attempt to model the discount generating process.

# Chapter 4

# Measuring Closed-End Fund Discounts and Returns

## 1. Introduction

This chapter describes some methodological issues relevant to the definition of the closed-end fund discount and the computation of total returns. In the following section, we compare different definitions and discuss some choices for measuring the average discount for a category or group of funds. We also define measures of total returns for share prices, indexes and NAVs. In Section 3 we explain the sample sizes and the time periods for each chapter of the study. Section 4 reviews the databases available for analysing the discount of the UK investment trust industry. Section 5 summarises.

## 2. Methodological Issues

### 2.1. The closed-end fund discount

This subsection presents the definition of the closed-end fund discount used in our analysis. We also define the measure of average discount for a category of funds.

#### 2.1.1. Definition of the discount

The discount on a closed-end fund is conventionally calculated as the difference between the share price and NAV divided by the NAV.

$$d_t = (P_t - NAV_t) \quad NAV_t) \tag{4.1}$$

where $P_t$ and $NAV_t$ are the share price and the NAV per share of the closed-end fund, respectively. However, following Pontiff (1995) we prefer to define the discount, $d_t$, as a logarithmic difference,

$$d_t \quad ln\,(P_t \quad NAV_t) \tag{4.2}$$

We use the log price to NAV ratio measure because it allows one to interpret changes in the discount as returns. Equation (4.5) below shows the equality. The definition of the discount as the logarithm of the price to NAV ratio implies that when this measure decreases, it corresponds to an increase in the level of the discount[86].

### 2.1.2. Average discount of a category or group of funds

Measuring the average discount of a category as the average of the funds' discount, where the discount is defined by Equation (4.2), corresponds to the logarithm of the geometric mean of the price to NAV ratio. Equation (4.3) shows the relationship.

$$\begin{aligned}\bar{\delta}_t &= \frac{1}{n}\sum_{i=1}^{n} \ln\,(P_i\,/\,NAV_i) = \frac{1}{n}\left[\ln\,(P_1 \; NAV_1) + \ln\,(P_2/NAV_2) + \ldots\ldots + \ln\,(P_n\,/\,NAV_n)\right] \\ &= \frac{1}{n}\ \ln\,\{P_1\,/\,NAV_1 * P_2\,/\,NAV_2 * \qquad * P_n\,/\,NAV_n\} \\ &= \ln \sqrt[n]{P_1/NAV_1 * P_2/NAV_2 * \qquad * P_n/NAV_n}\end{aligned} \tag{4.3}$$

This would not be, however, the normal way of computing the average discount for a group of funds. Equation (4.4) defines the average discount, $\bar{d}_t$, of a category or group of funds as the logarithm of the equally-weighted average of the price to NAV ratios,

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[86] Pontiff (1995), page 344, points out that the conclusions of his paper are unaffected if the discount is defined as in Equation (4.1). Preliminary testing on our data shows that this is also the case for the UK.

$$\bar{d}_t = \ln \left( \frac{1}{n} \sum_{i=1}^{n} P_{i,t} / NAV_{i,t} \right) \tag{4.4}$$

where $n$ is the number of funds in a category[87]. It would be incorrect to use Equation (4.3)[88]. Bodie, Kane and Marcus (1996), page 67, show that the geometric mean is less than the average mean, implying that $\bar{\delta}_t \cdot \bar{d}_t$. Since most funds trade at a discount, $|\bar{\delta}_t| > |\bar{d}_t|$, which corresponds to a more substantial discount using Equation (4.3). Therefore, the geometric mean makes the discount on an equally-weighted portfolio look more extreme than the correct formula (4.4).

### 2.1.3. Discount first difference

The definition of the discount as described in Equation (4.2) implies that, if there are no dividends, changes in the discount are equivalent to the difference between the share price return and the NAV return:

$$\begin{aligned} \Delta d_t &- d_t - d_{t-1} \\ &= \ln(Price_t) - \ln(NAV_t) - [\ln(Price_{t-1}) - \ln(NAV_{t-1})] \\ &- R_{Price,\,t} - R_{NAV,\,t} \end{aligned} \tag{4.5}$$

where $R_{Price,\,t}$ is the continuously compounded return on share price and $R_{NAV,\,t}$ is the continuously compounded return on the NAV. And if there are dividends,

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[87] When we measure the average discount of the entire UK investment trust industry, $n$ is the total number of funds trading at time $t$.

[88] Lee, Shleifer and Thaler (1991) construct an index of discounts based on the definition of the discount described in Equation (4.1). They, therefore, do not have the problem of averaging log ratios.

$$\Delta d_t = R_{Price,\,t} - R_{NAV,\,t} + d_t - d_t^{*} \qquad (4.6)$$

where $d_t^{*} = ln(Price_t + Div_t) / (NAV_t + Div_t)$. For investment trusts (though not necessarily for companies), $Div_t$ is small compared to both $NAV_t$ and $Price_t$[89]. It follows that the last two terms in Equation (4.6) are of negligible magnitude compared to the first two terms.

### 2.1.4. Absolute value of the discount for a group of funds

In this thesis we also explore the relationship between discounts and funds' residual risk[90]. We use the absolute value of the discount, defined as follows

$$| \mathrm{d}_t | - | \ln (P_t / NAV_t) | \qquad (4.7)$$

We define the average absolute value of the discount for a group of funds as the logarithm of 1 plus the equally-weighted average of the absolute value of price to NAV ratio minus 1.

$$| \mathrm{d}_t | \quad \ln \left\{ 1 + \frac{1}{n} \sum_{i=1}^{n} | P_{i,t} \quad NAV_{i,t} - 1| \right\} \qquad (4.8)$$

where $n$ is the number of funds in the group.

## 2.2. Total returns

This section defines total returns for closed-end fund share prices, indexes and NAVs. We discuss the computation and the choice of the measure of income growth.

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[89] The average value for $\mathrm{Div}_t$ / $\mathrm{Price}_t$ across all years and trusts in our database is 2.4 percent; the average value for $\mathrm{Div}_t$ / $\mathrm{NAV}_t$ is even lower than this.

[90] This research is reported in Section 4.4 of Chapter 5.

### 2.2.1. Price returns

Following Fama and French (1998), we define monthly share price total returns as the sum of the monthly share price capital growth and one-twelfth of the fund's annual dividend yield

$$\begin{aligned} R_{Price\,j,t} &= \ln[(P_{j,t}\ \ P_{j,t-1}) + 1\ 12 \cdot DY_{j,t-1}] \\ &\ln[(P_{j,t}\ \ P_{j,t-1}) + 1\ 12 \cdot (div_{j,t-1}\ \ P_{j,t-1})] \\ &= \ln[(P_{j,t} + Div_{j,t})\ \ P_{j,t-1}] \end{aligned} \tag{4.9}$$

where $P_{j,t}$ is the share price of fund $j$ at time $t$, $DY_{j,t-1}$ is the annual dividend yield measured at time $t-1$ and $div_{j,t-1}$ is the value of the expected annual dividend. We approximate the dividend paid by the fund at time $t$, $Div_{j,t}$, by one-twelfth of the expected annual dividend.

We show in Section 3.2 of Chapter 5 that, as compared to using the actual dividend payments and information on ex-dividend dates, this approximation has a negligible impact on our empirical results. The Fama and French definition of returns does, however, enable us to use the same formula for share returns as for index returns, as we demonstrate in the next section.

### 2.2.2. NAV returns

We define monthly NAV total returns as the sum of the monthly NAV capital growth and one-twelfth of the fund's annual dividend yield. Based on the evidence that the share price usually differs from the NAV, we adjust the dividend yield as follows:

$$\begin{aligned} R_{NAV\,j,t} &= \ln[(NAV_{j,t}\ \ NAV_{j,t-1}) + 1/12 \cdot (DY_{j,t-1} \cdot P_{j,t-1}/NAV_{j,t-1}))] \\ &= \ln[(NAV_{j,t}/NAV_{j,t-1}) + 1/12 \cdot (div_{j,t-1}\ \ NAV_{j,t-1})] \\ &= \ln[(NAV_{j,t} + Div_{j,t}) / NAV_{j,t-1}] \end{aligned} \tag{4.10}$$

where $NAV_{j,t}$ is the net asset value of fund $j$ at time $t$, $DY_{j,t-1}$ is the annual dividend yield measured at time $t-1$ and $div_{j,t-1}$ is the value of the expected annual dividend. Given that the dividends from the shares in the portfolios are not distributed at the same time, we approximate the dividend paid by the portfolio in month $t$, $Div_{j,t}$, by one-twelfth of the expected annual dividend paid by the fund. The closed-end fund dividend is paid out of the portfolio's income, after deducting expenses[91]. This measure of total NAV return is, therefore, net of expenses.

### 2.2.3. Index returns

We define monthly index total returns as the sum of the monthly index capital growth and one-twelfth of the index's annual dividend yield.

$$\begin{aligned} R_{Index\,i,t} &= \ln[(Index_{i,t}\ \ Index_{i,t-1}) + 1\ 12 \bullet DY_{i,t-1}] \\ &\quad - \ln[((Index_{i,t}\ \ Index_{i,t-1}) + 1\ 12 \bullet (div_{i,t-1}\ \ Index_{i,t-1})] \\ &= \ln[(Index_{i,t} + Div_{i,t}) / Index_{i,t-1}] \qquad (4.11) \end{aligned}$$

where $Index_{i,t}$ is the value of index $i$ at time $t$, $DY_{j,t-1}$ is the annual dividend yield measured at time $t-1$ and $div_{j,t-1}$ is the value of the expected annual dividend. We approximate the dividend paid by the index in month $t$, $Div_{j,t}$, by one-twelfth of the expected annual dividend.

## 3. Sample Sizes and Time Periods

The UK closed-end fund industry consists of approximately 360 funds, with a total market capitalisation of over £47 billion. Each of the funds is allocated to one of the 20 categories described in Table 2.1. This study investigates almost the entire UK investment trust industry, with the exception of funds that invest in unquoted securities

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[91] By law at least 85 percent of the dividend received from the holdings must be paid out. Dividends are paid out of income, not out of capital. Since 1996 UK closed-end funds are allowed to allocate management expenses and borrowing costs between income and capital.

(Venture & Development), specialist funds (Commodity & Energy and Property), Emerging Market funds and Split Capital Trusts - this leaves us with fifteen categories with a total number of funds of 244. Table 6.1 details the funds and their management. In Chapter 5 we extend the sample to include 94 dead funds - the overall sample covers 338 different funds. In Chapter 7 we exclude the funds for which we have less than 18 months of data (42 funds were issued between July 1995 and December 1996). The overall sample includes 202 funds. Finally, in Chapter 8 the sample covers 172 IPOs, 94 open-ended funds, 33 rights issues and 37 "C" share issues.

For most of this study we investigate the behaviour of UK closed-end fund discounts over the period January 1980 to December 1996. The exception is Chapter 7 where the time period starts in January 1981. This interval was chosen because most of the data was available since 1981[92]. For Chapter 6, for which an additional quarter of data was available, we consider the interval from January 1980 to March 1997.

## 4. Investment Trust Databases

This section describes the sources of data available for the analysis of the UK investment trust industry.

### 4.1. Association of Investment Trust Companies (AITC)

The AITC's members are required to provide monthly[93] valuations of the net asset value of their trust. The actual net asset values must be calculated using AITC formulations. The AITC collects the net asset values from all the investment trusts and publishes them 6 working days after the end of the month.[94] The AITC database, run by NatWest Securities Ltd., includes monthly values since 1963. Total returns (capital and income) are also calculated.

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[92] We have subsequently acquired data that would allow us to go back to 1980 but, because this is not likely to change the results, we delay using it to future research.

[93] Venture capital trusts usually do not reveal net asset values more than twice a year because it is difficult to value their unquoted assets.

Since 1984, the AITC has published annually the "Directory"[95] of the investment trusts that are members of the Association. The Directory includes information on the funds' investment policy, trust managers, capital structure, shareholder details, portfolio profile, share price performance and historical records.

The AITC also publishes the "Monthly Information Service" including monthly data on each fund's portfolio exposure, NAV, share price, discount, gearing, total returns, management, PEP status, saving schemes, dividend payment date and winding-up options.

## 4.2. NatWest Securities Ltd.

NatWest Securities Ltd. produces daily values of investment trusts, since 1987. The database includes:

- Prices
- Market values
- Net asset values (NAVs)
- Dividends: the database includes the value of the dividends paid by the investment trusts, but total returns are not calculated. For recent periods, the database provides the ex-date as well as the announcement day of the dividend.

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[94] In the UK there are some trusts that reveal their NAVs daily and weekly, but most do so monthly. In the US, NAVs of closed-end funds are published weekly.

[95] Since 1996, the AITC directory of investment trusts is published in the AITC publication "Complete Guide to Investment Trusts".

- Shareholdings : shareholdings larger than 3 percent are listed. These values are published monthly, but they are updated more frequently.
- P/E ratios
- Convertible shares ('C' shares)[96]
- Buy/Sell recommendations
- Volume

Every fund member of the AITC reveals its NAV monthly, or sometimes more frequently. During the period between the announcement of the exact value of the portfolio, NAVs are estimated. NatWest Securities estimates daily NAVs using the following model:

1) The year-end balance sheet characterises the capital structure and the portfolio holdings of the trust.

2) Holdings larger than 2 percent are listed and updated according to the individual share price.

3) The remaining holdings are allocated to different groups according to the exposure to a geographical area and to a particular sector. The value of each group is updated by the relevant industry share index. These estimates are adjusted as soon as new information is revealed. The percentage difference is used as a constant adjustment factor (B-factor) that transforms the estimated value into the actual value. If the difference between the estimated value and the actual value is larger than 2 percent, the model is re-estimated (the geographical and sector exposures are re-calculated).

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[96] See Chapter 8 for a description of "C" shares.

4) NAVs are estimated five times a day[97]. The daily estimates that are stored in the database correspond to a value calculated overnight (when New York has also closed) and all indexes become available. Extel consolidates all information on the trust and this value is stored on the database.

5) The estimated net asset values are adjusted using a different procedure from the one described in the next subsection for Datastream. In the NatWest database, the change or "jump" occurs when the actual value becomes available. The current estimate is replaced by the actual value, but the previous estimated values are not modified. Net asset values are given undiluted and diluted (assuming that warrants are exercised).

6) Prior charges are valued at par[98].

Since 1992, NatWest has published the semi-annual Investment Trust A-Z. This provides very detailed summary statistics for each of the UK investment trusts. It also issues regularly the "Sector Update".

NatWest Securities also calculates an Inertia Scenario. The value added by the manager is calculated by comparing the value of the investment trust's portfolio to the value of an "inertia portfolio" - where the proportions of investment are assumed to be constant over time. However, this approach is limited in terms of the breakdown of the portfolio's investments, as only five indexes are used to proxy the relevant exposure[99].

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[97] 7.30 a.m., 9.30 a.m., 11.30 a.m., 1.30 p.m. and 4.30 p.m.

[98] Originally, prior charges used to be valued also at market value. Because of the insignificant difference between the two procedures, market value estimation has been dropped.

## 4.3. SBC Warburg

SBC Warburg's database includes 900 closed-end funds (of which 300 are UK[100] investment trusts) and starts in 1988. The database includes price, market values, NAVs, volume (data on volumes of trading is available since 1994), shareholdings, dividends and Buy/Sell recommendations (IBES is used when Warburg's forecasts are not available).

SBC Warburg publishes annually the "Private Investor Guide" including a detailed description of each category of investment trust companies. It also issues weekly information and data on all international closed-end funds - not only UK traded funds - including share price, NAV, discount, portfolio exposure, gearing, dividends and warrants.

NAVs are estimated as follows

1) The AITC reveals the holdings at the beginning of the month and NAVs are calculated.

2) NAVs are estimated over the month taking into account the exposure to the market and sector.

3) Until very recently, the database did not adjust for any difference between the estimated value and the actual value published at the end of each month.

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[99] The Inertia Scenario procedure is similar to Sharpe's (1992) returns-based style analysis described in Chapter 5. Both methodologies measure managerial performance after adjusting for factor exposure.

Warburg has now introduced a ‘Smooth Routine’ which is such that, once the actual holding are revealed by the AITC, the difference between the estimated and actual value is computed and adjusted backward, pro rata (1/N, where N is the number of trading days), over the previous month.

4) NAVs are diluted for warrants and convertibles, where appropriate. When the warrants are ‘in the money’, both market capitalisations and net assets reflect the amounts based on the diluted number of shares. However, if the warrants are ‘out of the money’, only total market capitalisation is adjusted by the market capitalisation of the warrants.

## 4.4. Datastream

Datastream provides daily data from 1970. The database includes prices, market values, NAVs, dividends and asset performance (index figures showing the current asset value as a percentage of the asset value at a specific base date). Values are available with prior charges deducted both at par and at market value.

Datastream estimates daily NAVs as follows:

1) The portfolios, as published in the latest accounts, are arranged in industry groups and the value of each group is updated daily by the relevant industry share index. The subdivision of the portfolio and the application of group share indices is taken to the most detailed level that is considered practical for both UK and overseas investments. Approximately 230 daily share indices are used in these calculations. Additionally, the largest investments of a trust (usually 1 percent or over) are updated according to the individual share price. All new information available is added to the model to recalculate the estimated NAV

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[100] Bond funds exists in the US but not in the UK.

and the backward adjustments are made (past estimates are changed when the model is recalculated using actual values[101]).

2) Information on any asset values is taken into account: (i) monthly AITC publications, (ii) monthly news letters sent by fund managers, and (iii) daily NAVs reported by fund managers through the Regulatory News Service (RNS), a wire service of the London Stock Exchange.

3) All convertibles are treated as if fully converted.

4) Asset values are calculated on the basis of deducting prior charges both at par (NAVP), and at market value (NAVM). These are taken as official list middle prices of the previous day.

5) Asset vales are not diluted for outstanding warrant issues. (NAVD - net asset values diluted - calculates NAVs assuming that the warrants are exercised. These have been available since early 1995).

Datastream also compiles daily information on NAVs for a consortium of six brokers - ABN AMRO, BZW Securities, Crédit Lyonnais Laing, HSBC James Capel, SBC Warburg Securities and UBS Limited.

## 4.5. Other sources of data

Most of the financial institutions dealing with the investment trusts have their research group and issue regular information on the sector. We review some of the most extensive sources of data.

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[101] Backward adjustment does not account for the fact that the actual NAV is unknown during the periods prior to the publication of this value. Therefore, for research purposes, it is not appropriate to replace past estimates. The NatWest database avoids this problem by leaving past estimates unchanged.

Crédit Lyonnais Laing annually publishes the "Investment Trust Yearbook". The publication includes details of the investment trust companies, the management groups and provides an extensive analysis of the sector performance.

The Closed-End Fund team of West Merchant publishes the "Monthly List" which includes prices, returns, asset allocation, and risk statistics for all international closed-end funds. Additionally, it issues weekly and monthly publications reviewing the industry.

The Investment Trust Research Group at Merrill Lynch publishes the "Investment Trust Quarterly" reviewing the changes and prospects of the industry as a whole, as well as individual funds.

And finally, ABN AMRO Hoare Govett regularly publishes information on the UK investment trust industry.

## 4.6. Conclusion

The comparison of the three databases - NatWest Securities, SBC Warburg and Datastream - shows that SBC Warburg provides extensive information on the international closed-end fund industry. The database is useful when investigating the behaviour of funds listed on different exchanges. On the other hand, NatWest Securities is a particularly extensive source of data for the UK investment trust industry, which is the market that our study focuses on. Datastream provides extensive data on all UK traded funds since 1970. It also includes most of the funds that disappeared. This study uses Datastream because it is an accurate and publicly available source of data.

## 5. Summary

This chapter describes some issues relevant to the definition of the closed-end fund discount and returns. We also describe the sample size and time periods for each part of the thesis. Finally, we review the databases available for analysing the UK closed-end fund industry.

# Chapter 5

# The Closed-End Fund Discount And Performance Persistence[102]

## 1. Introduction

As explained in Chapter 2, a closed-end fund is a collective investment company that typically holds other publicly traded securities. Its purpose is to provide investors with two services - diversification and management. The closed-end fund is so-called because its capitalisation is fixed, or "closed", which implies that the share supply is inelastic. Thus, the price is a function of the supply and demand for the shares trading on the market and has no direct link with the value of the assets corresponding to each share. To liquidate their holding, investors must sell their shares to other investors. An important characteristic that makes these securities unique is that they provide contemporaneous and observable market-based rates of returns for both stocks and underlying asset portfolios.

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[102] A predecessor to this chapter was presented at the Doctoral Colloquium, European Finance Association, Milan 1995. This research was also presented at the Inquire Conference, Leeds 1997 and at the European Finance Association, Vienna 1997. The research was funded by Edward Jones, Salomon Brothers' scholarship from London Business School and received the StyleADVISOR prize, 1997. For useful comments, I thank Edwin Elton, Martin Gruber, Michael Rockinger, Dick Brealey, Sam Wylie, Sabrina Kwan, Hamish Buchan and my supervisor Elroy Dimson.

Net asset value (NAV) is defined as the market value of the securities held less the liabilities, all divided by the number of shares outstanding. For many funds the value of the portfolio is known with considerable accuracy since the component assets are quoted on the stock market. However, closed-end funds typically trade at a substantial discount to the underlying value of their holdings, the NAV of the fund. The discount is not constant, and varies considerably over time, as illustrated in Figure 2.1.

The history of the UK closed-end fund discount and premium mirrors the popularity of these funds. In the 1960s, when closed-end funds were still popular with private investors, the discount used to fluctuate around 10 percent. By the middle of the 1970s, private as well as institutional investors lost interest in such funds and the discount widened to 40 percent. The bull market of the 1980s and the introduction of new classes of shares, savings schemes and Personal Equity Plans[103], renewed interest in the closed-end fund industry. By the end of 1992 the average discount had gradually narrowed to 5 percent but the trend seems now to be reversing.

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 behaviour of the discount of the Germany Fund in the US. During the winter of 1989-90, after the fall of the Berlin Wall, the Germany Fund, which typically traded at a discount, moved to a premium of over 100 percent. This dramatic rise was attributed to speculation on the part of investors looking at new investment opportunities in Germany. For a long time after this episode, the Germany Fund traded at a premium. What made the behaviour even more intriguing was that it seemed to carry a cross-border contagion and other country funds (Austria, First Iberian, Italy, Swiss, Malaysia, Thai and Taiwan) experienced dramatic but short-lived increases (decreases) in the premium (discount). The fluctuation of these discounts, over time as well as across funds, is difficult to explain.

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[103] Saving schemes, introduced in 1984, allow for a lump sum investment or a regular amount each month - the minimum amounts are usually as low as £250 (approximately $400) for a lump sum and £25 ($40) on a monthly basis - at low rates of commission. Personal Equity Plans (PEPs) were introduced by the Government in 1986 to encourage private investment in the UK stock market. The attraction is that income and capital gains from a PEP investment (maximum of £6,000 (approximately $10,000) per tax-payer per year) are entirely tax free.

Large fluctuations over time in the average discount are not the only characteristic of closed-end funds. The level of discount also differs considerably from one fund to another and this chapter aims to explain at least part of this difference. Section 2 of this chapter reviews key elements of the literature on closed-end funds, drawing on the survey presented earlier in Chapter 3. Several theories have attempted to explain the existence of the discount - agency costs (managerial performance and the present value of management fees) and miscalculation of the NAV (illiquid assets and tax liabilities related to unrealized capital gains) - but none has been able to provide a full explanation. As a result, the literature abandoned the efficient market framework and introduced investor irrationality. Individuals, who are the major shareholders of US funds, are identified as irrational investors who trade on 'sentiment', in contrast to institutions that behave rationally. However, this approach is inconsistent with the empirical evidence of persistent discounts for UK closed-end funds, which are dominated by institutional owners rather than private.

Section 3 revisits the managerial performance theory - discounts and premiums reflect the perception of managerial ability to perform relative to a passive investment strategy - rectifying some of the weaknesses of the traditional definition of managerial performance. The literature usually defines management performance as the NAV return. Consistent with Pontiff's (1995) findings for the US market, we find that the predictive power of the discount relates mostly to predicting future share price rather than future NAV returns. Failure to observe a relation between discounts and future NAV returns implies either that the relationship does not exist or that the power of the test is too low to detect it. However, managerial performance should be measured after adjusting for factor exposure. To define the value added by active management we use two methodologies - unconstrained and constrained multi-index regression.

Section 4 shows the results. The analysis does not confirm Gruber's (1996) results and finds no persistence in managerial performance. In terms of the pricing of the funds, we also find that share price returns exhibit no performance persistence. On the contrary, there is weak evidence of price reversal. Gruber (1996) suggests that because closed-end funds are traded companies, the price should incorporate the expectations of managerial performance. The results provide no support for this conjecture. Discounts weakly reflect past performance, but do not seem to predict managerial performance. We therefore find no support for the conjecture, believed to be true by practitioners, that discounts reflect the quality of the management.

Empirical evidence shows that closed-end funds systematically trade at a price which differs from NAV. If there is a cost to arbitrage, the greater the difficulty to hedge the exposure, the larger the mispricing. Pontiff (1996) shows that funds with larger unhedgeable risk trade at higher discounts. Using our sample of British funds we estimate the funds' residual risk and confirm Pontiff's (1996) results. The higher the basis risk, the larger the discount. Section 5 concludes the paper.

## 2. Literature Review

Closed-end funds are characterized by one of the most puzzling anomalies in finance - the existence and behaviour of the discount. Closed-end fund shares are issued at up to a 10 percent premium to net asset value. This premium represents the underwriting fees and start-up costs. Subsequently, often within a matter of months, shares trade at a discount. Upon termination (liquidation or 'open-ending') of the fund, the share price rises and the discount disappears. This section reviews some key elements of the literature on US and UK closed-end funds, drawing on the survey presented in Chapter 3.

## 2.1. US studies

The mutual fund industry is divided into open- and closed-end funds. The latter suffer from a number of restrictions in terms of tax and regulatory status. Closed-end funds are required to distribute 90 percent of realized capital gains to qualify for exclusion from corporation tax. Like open-end funds, they are not allowed to leverage. However, closed-end funds have been a popular vehicle for enabling investors to gain exposure to specialized portfolios, often with a focus on foreign or illiquid assets.

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 explain all parts of the puzzle. Two essential classes of explanation are miscalculation of the NAV and the existence of agency costs. The NAV may be misestimated because of tax liabilities related to unrealized capital gains or because of illiquidity of the funds' holdings. Under fairly generous assumptions, Malkiel (1977) finds that tax liabilities can account for a discount of no more than 6 percent. Furthermore, the evidence that price rises upon open-ending (Brauer (1984), Brickley and Schallheim (1985)) does not support the hypothesis that NAV is overestimated. The agency cost theory claims that the discount is a consequence of investors anticipating managerial dissipation and capitalizing future management fees. Malkiel (1977), however, finds no correlation between discounts and management expenses. The performance hypothesis suggested by Boudreaux (1973) claims that discounts reflect the expectation of future managerial performance. However, Malkiel (1977), Lee, Shleifer and Thaler (1991) and Pontiff (1995) find no significant relationship between discounts and future NAV performance. Roenfeldt and Tuttle (1973) find only a weak relationship in contemporaneous performance.

The most severe difficulty that the above mentioned explanations face is coping with the original issue of closed-end funds. Such funds start out priced some 10 percent above NAV; but within 24 weeks of trading Weiss (1989) shows that US stock funds can be expected to trade at a significant average discount of 10 percent (also see Peavy (1990)). Given the likelihood that they will sell below NAV in the near future, it is difficult to see why any investor, whose decisions are motivated by rational factors rather than by irrational sentiment, would hold such assets. The initial public offering of closed-end fund shares may well require modification, or even suspension, of the efficient market hypothesis.

A theory that responds to some aspects of the puzzle is the limited rationality model of De Long, Shleifer, Summers and Waldmann (1990). They assert that 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. Like fundamental risk, noise trader risk will be priced at equilibrium because fluctuations in individual investor sentiment are correlated across investors, implying that this additional risk cannot be diversified. Furthermore, Lee, Shleifer and Thaler (1991) show that discounts are correlated with the price of other securities, such as small stocks, which are affected by the same investor sentiment.

## 2.2. UK studies

Compared to their American counterparts, UK closed-end funds, known as investment trusts, have a number of advantages. Other than the obligation to distribute at least 85 percent of the dividends received from their holdings, they benefit from considerable flexibility. UK closed-end funds are allowed to borrow and many of them make use of this opportunity to leverage their portfolios. Capital gains cannot be distributed and are therefore reinvested in the fund, but capital gains have been exempt from corporate taxation since 1980.

Numerous researchers have investigated the closed-end fund discount, in particular in relation to the US market. Despite some differences in leverage, taxation and ownership structure, the behaviour of UK discounts is in many respects similar to the US. Many theories suggest an explanation for the existence and behaviour of the discount, but since none solve all parts of the anomaly, some scholars have found it necessary to resort to models of investor irrationality.

The limited rationality theory is based on the observation that (in the US) individual investors own the largest proportion of closed-end fund shares. UK closed-end funds have gone through periods of discount and premium, similar in most respects to US funds. However, Ammer (1990) argues that the investor sentiment hypothesis does not hold when applied to the UK market. The UK clientele is, and has been over the last decade, almost entirely institutional (70 to 75 percent in 1990)[104]. Despite this inconsistency, Levis and Thomas (1995) show that UK closed-end fund IPOs are subject to 'hot' issue periods - IPOs tend to occur when there is a marked narrowing in the discounts of seasoned trusts - which is related to the implications of the De Long et al (1990) noise trader model. UK closed-end fund IPOs disclose an aftermarket performance similar to that observed for general equity IPOs. When compared to US funds, the results show that the long-term underperformance is smaller. Larger institutional ownership in the UK is suggested as a possible explanation for that difference.

Draper (1989) investigates the UK closed-end fund industry and finds that share prices react rapidly to the announcement of takeovers, open-ending and liquidation. He shows that by the end of the announcement month all the information about the open-ending has been incorporated in the price and no significant rise occurs thereafter. Compared to Brauer's (1984) results for US closed-end funds, prices in the UK market seem to react more rapidly to the announcement of open-ending. Furthermore, Draper demonstrates that significant returns are earned investing in open-ending funds at the time of the announcement only if using mid-market prices. Substituting ask prices adjusted for transaction costs reduces abnormal returns to levels not even approaching those found by Brickley and Schallheim (1985). With respect to open-ending, the behaviour of investment trusts is generally rational and the market for closed-end fund shares seems efficient. If these traits characterise closed-end funds in general, then the persistent discounts at which most funds sell demand a careful search for a rational explanation.

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[104] S.G. Warburg (1990) reports that by the end of the 1980s, 93 per cent of funds had the majority of their shares registered to institutions.

This chapter revisits one of the traditional theories - managerial performance. The theory predicts that if the fund pays more than the "fair value" for managerial expertise, its shares should sell at a discount or earn an abnormally low return on investment, and vice versa. Previous studies did not find any conclusive results. However, they defined managerial performance as the total return on the fund's NAV whereas we introduce a measure of managerial performance that adjusts for the fund's effective asset exposure.

## 3. Managerial Performance[105]

One of the first academic papers to suggest a relationship between discounts and future managerial performance is Boudreaux (1973). He argues that the persistent divergence of the price from NAV is consistent with market efficiency and depends on future portfolio alterations. The price can be expected to equate to (or to diverge by a constant proportion of) its NAV only if the market believes that the fund manager would never alter the holdings of the portfolio. Discounts and premiums reflect the perception of managerial ability to perform relative to a passive investment strategy.

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[105] I thank Professor Martin Gruber for suggesting the investigation of the relationship between managerial performance and closed-end fund discounts.

The quality of mutual fund management has been investigated in the literature largely in relation to stock-picking or market-timing ability. Chevalier and Ellison (1996) extend the research and show that managerial characteristics - age and average SAT score of his/her undergraduate institution - can predict future returns. Based on the assumption that some managers are simply better than others, this chapter tests the hypothesis that discounts reflect investor expectations of future managerial performance - funds trade at a smaller discount (or even at a premium) if the market anticipates good managerial performance. Ammer (1990) reports that casual readings of British closed-end fund managers' trade publications suggest that this view is prevalent among practitioners in the UK[106].

The evidence presented by Malkiel (1977), Lee, Shleifer and Thaler (1991) and Pontiff (1995), as well as the results from the analysis described in section 3.2, all contradict the managerial performance theory. No significant positive correlation is found between discounts - defined as the logarithmic price to NAV ratio - and future managerial performance, when the performance is measured by the NAV return.

We therefore need a definition of performance that can capture the ability of the manager to select the "right" stocks. The idea is that if a fund is exposed to a market which is doing well, this does not imply that the manager is necessarily good. The manager outperforms only if he does better than this particular market. We introduce a multi-index model to adjust for the fund's effective asset exposure, and thereby obtain a more refined measure of managerial performance.

## 3.1. Data description

There are around 360 UK closed-end funds, with a total market capitalization of over £47 billion. Each of the funds is allocated to one of the 20 categories described in

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[106] Discussions with closed-end fund market-makers and analysts reveal that they believe the discount is related to managerial performance.

Table 2.1. The UK investment trusts represent more than 15 percent of all securities listed on the London Stock Exchange and approximately 4.5 percent of the total market capitalization. Closed-end funds, referred to as investment trusts in the UK, are typically members of the Association of Investment Trust Companies (AITC). The AITC provides monthly information on the performance of each of its member trusts. For all UK closed-end funds Datastream provides share price and undiluted NAV with prior charges valued at par[107]. Discounts and returns are computed for the period January 1980 to December 1996. See Section 2 of Chapter 4 for the definition of the discount and index, share price and NAV monthly returns.

In the sample investigated in this study, approximately 30 percent of the funds die. Elton, Gruber and Blake (1996b) estimate the size of survivorship bias in measures of mutual fund performance, and show that the relevance of fund characteristics can be misinterpreted by the failure to account for the bias. Many studies have investigated new methodologies to measure performance, but few have been concerned with bias in the data. The problem of funds disappearing because of poor performance may result in evidence of performance persistence when there is none. Our analysis avoids the survivorship bias and includes the 94 funds that disappeared during the period 1980-96; 56 as a result of a merger or bid, 34 unitised (open-ended) and 4 liquidated. These correspond to the funds that Datastream classifies as "dead" funds and for which it keeps a back history. Our analysis investigates almost the entire UK investment trust industry, with the exception of funds that invest in unquoted securities (Venture &

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[107] NAV is defined as the market value of total assets less all prior charges values at their par or asset value, all divided by the number of shares in issue. Prior charges are defined as including all debentures, all loans and short term loans and overdrafts that are to be used for investment purposes, reciprocal foreign currency loans, currency facilities to the extent that they are drawn down, index-linked securities, all types of preference or preferred capital and the income shares of split capital trusts. None of these prior charges are treated as current liabilities even if they are short-term and would so appear in a published balance sheet. Originally, prior charges used to be valued also at market value. Because of the insignificant difference between the two procedures, market value estimation has been dropped.

Development), specialist funds (Commodity & Energy and Property), Emerging Market funds and Split Capital Trusts - fifteen categories with a total number of funds of 244. Including the 94 dead funds, the overall sample covers 338 different funds. Table 6.1 details the funds and their management.

### 3.2. Predictive power of discounts

Based on our sample of fourteen closed-end fund categories, we compute the category discount autocorrelogram over the period from January 1980 to March 1997. The results, which are presented in detail in Chapter 6, show a very high autocorrelation. Using monthly data, the average first-order autocorrelation is about 0.93 and decays to 0.64 for the twelfth-order autocorrelation. This persistence implies that current discounts contain information about future discounts. For a fund with average autocorrelation, the first order autoregressive process can explain 86.5 percent (the square of 0.93) of the discount variation. The question now is to determine whether this predictive power of the discount levels can explain either future share price returns, NAV returns, or both.

One of the traditional theories of the discount claims that discounts reflect future managerial performance. The literature usually defines this performance as the return on NAV. The analysis of the correlation between discounts and future returns measures the predictive power of discounts and tests the hypothesis that:

$$\begin{aligned} &H_0: \rho = 0 \\ &H_1: \rho > 0 \end{aligned} \tag{5.1}$$

where $\rho$ is the correlation coefficient between discounts and subsequent NAV returns. The Pearson correlation coefficient measures the correlation between discounts and returns computed over the following one-month to one-year periods. The returns are based on non-overlapping observations. The bid/offer spread and thin trading may induce a negative autocorrelation between discounts and share price returns, both computed for the same time $t$ share price. To adjust for this bias we measure the autocorrelation with a one-month gap between discounts and returns. Returns are measured over one-month to one-year periods, with non-overlapping observations. Table 5.1 shows the average correlation for the 338-fund sample and the corresponding t-statistics[108]. Returns are continuously compounded.

Table 5.1. Correlation between Discounts and Subsequent Price and NAV Returns

The correlation between discounts and subsequent price and NAV total returns is computed for each of the 338 closed-end funds. Discounts are defined as $D_t = ln (P_t \;\; NAV_t)$. Returns are measured over one-month to one-year periods, with non-overlapping observations. The results are the equally-weighted average correlation coefficient across the 338 funds. We also report the t-statistic for the correlation coefficient. To avoid the negative autocorrelation induced by the bid/offer spread and thin trading, we introduce a one-month gap between measuring discounts and returns. We use data from January 1980 to December 1996.

| Measure of return | | 1 month | 3 months | 6 months | 12 months |
|---|---|---|---|---|---|
| Price return | Correlation | -0.17 | -0.22 | -0.24 | -0.38 |
| | t-statistic | -2.43 | -1.81 | -1.38 | -1.57 |
| NAV return | Correlation | -0.05 | -0.05 | -0.07 | -0.26 |
| | t-statistic | -0.67 | -0.44 | -0.41 | -1.04 |
| | Number of obs. | 204 | 68 | 34 | 17 |

The results show that large discounts (low ratios of share price to NAV) tend to be associated with high price and NAV returns. The negative correlation is stronger using share price returns. However, with the exception of the correlation between discounts and one-month price returns, the t-statistics show that the correlation coefficients are not significant[109].

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[108] The t-statistic for the correlation coefficient is measured as follows:

$t = r_{x,y} \sqrt{N-2} \; / \; \sqrt{1-r_{x,y}^2}$ where $r_{x,y}$ is the correlation coefficient between discounts and returns. N is the number of observations.

[109] Total share price returns are measured using one-twelfth of the expected annual dividend as an approximation for the dividends (see Section 2 of Chapter 4). To determine whether our approximation for the dividends affects the results of our study, we replicate the methodology for measuring the correlation between discounts and subsequent share price returns using actual dividend payments and information on ex-dividend dates. Based on our sample of International General category funds, we find an average correlation between discounts and subsequent one-month share

The predictability of share price returns is related to the evidence that discounts are mean-reverting: share price tends to increase when discounts are very large (see Chapter 6). The possibility of trading on past share price information might suggest that the pricing of closed-end fund shares is inefficient. On the other hand, Brauer (1984) and Draper (1989) both provide strong evidence that share prices react very quickly to new information. Therefore, it is reasonable to argue that since investors are fully aware of discounts, the apparent abnormal performance may be a condition of equilibrium.

Turning to the managerial performance hypothesis, we can examine whether smaller discounts are associated with higher NAV returns. Our empirical results show a slight (though non-significant) negative correlation between discounts and subsequent NAV returns. In other words, smaller discounts (high share price to NAV ratio) are not associated with future high NAV returns. Consistent with Malkiel (1977) and Pontiff (1995), this analysis contradicts the managerial performance hypothesis because it finds no evidence of positive correlation between discounts and NAV returns. Such results explain why so few studies have looked at managerial performance. However, the non-rejection of the null hypothesis implies either that the relationship does not exist or that discounts can predict future performance but the power of the test is too low to detect it. The objective of this chapter is to revisit the managerial performance theory and explain those results by rectifying the weaknesses of the traditional definition of managerial performance.

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price returns of -0.14 (-0.12). In brackets we report the corresponding values using our approximation for dividends. For three-, six-month and twelve-month share price returns we find -0.17 (-0.20), -0.22 (-0.26) and -0.32 (-0.38) respectively. The results tend to suggest that using the approximation for dividends does not affect the conclusions of our study. The correlation coefficients using the two definitions for the dividends are very similar and none is significant.

## 3.3. Methodology

This section defines managerial performance using two different methodologies - the unconstrained and the constrained multi-index regression. Both measure managerial performance after adjusting for the fund's effective asset exposure - NAV returns[110] are regressed on a set of indexes - over the period 1987-1996. The first approach follows Gruber (1996) and defines performance as the intercept, the alpha, of a multi-index unconstrained regression. The Gruber approach defines fund exposures based on the asset mix over the entire analysis period. Since this does not allow for the fund to change exposure over time, we replicate the results using a rolling window methodology and compare the adjusted R-squared. The alternative approach is Sharpe's (1992) returns-based style analysis, in which factor loadings are constrained to be non-negative and sum to unity[111]. The unconstrained and constrained regressions provide measures of managerial performance. We compare the different methodologies and investigate the relationship between discounts and future managerial performance. We also test for the existence of performance persistence.

### 3.3.1. Unconstrained multi-index model

The methodology of running a multi-index unconstrained regression to adjust for the risk of the fund, follows Elton, Gruber and Blake (1996a) and Gruber (1996). They investigate the persistence of risk-adjusted mutual fund performance identifying four factors: the local equity market index (in their case, the S&P 500), a size index, a bond index and an index which measures the performance of capital versus income-growth stocks. The last factor is introduced because of the importance of the market-to-book ratio in explaining returns (Fama and French, 1993). Elton, Gruber and Blake (1996a) define the performance of US mutual fund managers as the intercept of this four-index regression[112]. In our research we introduce two types of factors - market and style indexes, the first measuring geographical risk and the second the sensitivity to size, value and debt index movements[113].

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[110] NAV returns, rather than share price returns, are used to measure managerial performance because they are not affected by the fluctuations of the discount.

[111] The usefulness of the constrained regression approach depends on the choice of the independent variables. It is important that such indexes be exhaustive and have returns that differ as much as possible.

Following Gruber (1996) we define one-, two- and three-year managerial performance as the alpha from one-, two- and three-year multi-index regression, respectively. We use weekly returns. The results from this approach are then compared to those obtained using a three-year rolling window.

Following Sharpe's (1992) returns-based style analysis we use monthly data and define managerial performance at time *t* - referred to as selection return - as the difference between the NAV return at time *t* and the return on a passive portfolio with the same style as the fund. The fund's style is estimated using returns from months *t-36* to *t-1*. The advantage of the rolling methodology is that it allows for changing in the fund's exposure over time.

*The alpha from a seven-factor model.* The definition of managerial performance as the alpha from a multi-index unconstrained regression follows Gruber (1996). The risk-adjusted performance of the funds is measured using a seven-factor model. The first four factors are categorised thus: two base indexes representing the weekly returns of the FT/S&P World index, and the FTSE 100 index, and two market indexes representing the weekly returns of the two geographical markets which most closely reflect the investment objectives of the trust [114]. Most of these funds have a significant exposure to the UK market. This gives rise to three style indexes measuring the size effect, the market-to-book effect and the debt premium[115]. The intercept, $\alpha_j$, from regressing NAV excess returns on the market and style indexes, measures the contribution of the manager to the performance of the fund.

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[112] The excess return of the funds (open-end funds sell at NAV) is regressed on the excess return of the S&P500, the difference in return between a small-cap and large-cap portfolio, the difference in return between a growth and value stock portfolio, and the excess return of a bond index.

[113] Dimson and Marsh (1983) show that the estimation of risk measures can be affected by thin trading. The London Business School Risk Measurement Service (January-March 1997) indicates that UK-listed closed-end funds do not suffer from liquidity problems - the value-weighted trading frequency for the entire industry is 0.41 days (ie, on average, closed-end fund shares are traded several times per day).

$$R_{NAV j,t} - R_{F,t} = \alpha_j + \beta_1 (R_{World,t} - R_{F,t}) + \beta_2 (R_{UK,t} - R_{F,t}) + \sum_{i(j)\,3}^{4} \beta_{i(j)} (R_{M\,i(j),t} - R_{F,t})$$
$$+ \beta_5 (R_{S,t} - R_{L,t}) + \beta_6 (R_{G,t} - R_{V,t}) + \beta_7 (R_{D,t} - R_{F,t}) + \varepsilon_{j,t} \quad (5.2)$$

where $\beta_i$ is the coefficient measuring the sensitivity of each factor. $R_{NAV,j}$ is the weekly NAV total return for fund $j$ and $R_{M,i(j)}$ represents the factor return on the $i^{th}$ geographical market that is appropriate for fund $j$. Index returns include dividends and are sterling denominated[116]. All indexes are described in Table 5.2. Using weekly data, we measure managerial performance over one-, two- and three-year periods. The alphas are computed starting from the beginning of each calendar year.

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[114] The AITC's monthly publications give a breakdown of exposures, fixed interest and cash versus investments in different equity markets, for each of its members. Based on the 30th June 1996 monthly report, we choose the largest holdings to determine those two markets. The factors are defined from the following market price indexes: MSCI Europe excluding UK, S&P 500 composite, Nikkei 500, MSCI Pacific Basin excluding Japan, Milan Banca Commerciale Italiana, MSCI France, MSCI Spain and DAX 100 price index.

[115] The UK size effect is measured as the difference between the return on the Extended Hoare Govett Smaller Companies index and the return on the FTSE 100 index. The FTSE 100 is used as a proxy for the return on large companies. The UK market-to-book effect is measured as the difference between the return on the FTSE 350 Growth index and the return on the FTSE 350 Value index. The UK debt premium is the difference between the return on the FTA Government All Stock index and the Interbank 1 month middle rate.

[116] The returns are sterling denominated and include the impact of appreciation/depreciation of the foreign currency relative to the sterling.

Table 5.2. Indexes Description

| Type of Index | Symbol | Definition | Source |
|---|---|---|---|
| Base Indexes | 1. $R_{World}$ | FT S&P World Index | Datastream |
| | 2. $R_{UK}$ | FTSE 100 Index | Datastream |
| Market Indexes | 3. $R_{US}$ | S&P 500 composite Index | Datastream |
| | 4. $R_{Japan}$ | Nikkei 500 Index | Datastream |
| | 5. $R_{Far\ East}$ | MSCI Pacific Basin excluding Japan Index | Datastream |
| | 6 $R_{Europe}$ | MSCI Europe excluding UK Index | Datastream |
| | 7. $R_{Italy}$ | Milan Banca Commerciale Italiana Index | Datastream |
| | 8. $R_{France}$ | MSCI France Index | Datastream |
| | 9. $R_{Spain}$ | MSCI Spain Index | Datastream |
| | 10. $R_{Germany}$ | DAX 100 Index | Datastream |
| Style Indexes | 11. $R_D$ | FTA Government All Stocks Index | Datastream |
| | 12. $R_F$ | UK Interbank 1 month (middle rate) | Datastream |
| | 13. $R_L$ | Extended Hoare Govett Smaller Companies Index | Dimson-Marsh (1997) |
| | 14. $R_G$ | FTSE 350 Growth Index | FT-SE International |
| | 15. $R_V$ | FTSE 350 Value Index | FT-SE International |

*Nine-factor model: three-year rolling window.* The three-year rolling window methodology uses the same indexes as in Equation (5.2), but no intercept is allowed and factors are expressed as single indexes. Managerial performance - referred to as selection return - is defined as the difference between the fund NAV return and the return on a passive portfolio whose style is estimated using the fund's previous three years of data. Equations (5.3) and (5.4) describe the two-stage procedure.

$$R_{NAVj,t} = \beta_{1,t} R_{World,t} + \beta_{2,t} R_{UK,t} + \sum_{i=3}^{n} \phi_i \cdot \beta_{i,t} R_{Mi,t} + \sum_{k=n+1}^{n+5} \beta_{k,t} R_{Sk,t} + \varepsilon_{j,t} \qquad (5.3)$$

$$S_t = R_{NAVj,t} - [b_{1,t} R_{World,t} + b_{2,t} R_{UK,t} + \sum_{i=3}^{n} \phi_i \cdot b_{i,t} R_{Mi,t} + \sum_{k=n+1}^{n+5} b_{k,t} R_{Sk,t}] \qquad (5.4)$$

where $n = 4$. $\beta_{i,t}$ is the coefficient measuring the exposure of fund $i$ and $b_{i,t}$ the estimate computed from Equation (5.3) using data from month $t-36$ to $t-1$. $S_t$ is month $t$ selection return. $R_{NAVj,t}$ is the monthly NAV total return for fund $j$, at time $t$. $R_{Mi,t}$

represents the factor return on the $i^{th}$ geographical market, for month $t$. $\phi_i$ is a binary variable determining the markets that are appropriate for fund $j$. For the nine-factor model $\phi_i = 1$ for two of the eight geographical markets and 0 for the other six markets. $R_{Sk,t}$ represents the factor return on the $k^{th}$ style index, for month $t$. Index returns include dividends and are sterling denominated. All factors are described in Table 5.2. Managerial performance is the sum of monthly selection returns over one-, two- and three-year periods. The rolling window methodology requires three years of data to estimate the first monthly selection return. In order to increase the coverage of the research, we back-fill the estimates of selection returns. We use data from month $t+36$ to $t+1$ to compute month $t$ performance. Post-1990 data are therefore employed to calculate out-of-sample selection returns for 1987-1989[117].

*Fifteen-factor model: three-year rolling window.* Since the beginning of the 1980s, the investment trust industry has introduced many new fund categories which makes it difficult to monitor each trust's classification over time. The two previous methodologies - the alpha from a seven-factor model and the rolling window approach using nine indexes - both define fund exposure using a regression based on an asset mix held at a particular period of time. The choice of the two geographical markets used to reflect the fund's exposure might result in a less-than-adequate model, as the two chosen market indexes may not capture the fund's true asset allocation. To adjust for this potential drawback we replicate the three-year rolling window unconstrained regression using a more extensive palette of indexes. Equations (5.3) and (5.4) measure the selection returns. For the fifteen-factor model, $n = 10$. The binary variable, $\phi_i$, is 1 for all market indexes. Index returns include dividends and are sterling denominated. The fifteen factors are described in Table 5.2.

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[117] Note that the 1987-89 back-filling procedure does not have any impact on the findings of this research. The conclusions from the returns-based style analysis are unchanged if we exclude the first 36 monthly rankings corresponding to the back-filling estimation of selection returns.

### 3.3.2. Constrained methodology: returns-based style analysis

The unconstrained regression approach potentially suffers from two drawbacks. First it makes use of estimated factor loadings, $\beta_i$, which can be inappropriate as measures of subsequent portfolio exposures. For example, the estimated $\beta_i$ may be negative, despite the fact that short sales of market exposure are unusual in the closed-end fund industry. Second, if the unconstrained approach defines the fund exposure based on the asset mix held at a particular period of time, it might fail to capture the true risk attributes of the funds that change exposure over time.

Returns-based style analysis, originally suggested by Sharpe (1992), is an alternative approach for measuring the value added through active management. This technique has been widely adopted by both researchers and investment professionals[118]. Sharpe uses quadratic programming to determine a fund's effective exposures to the major asset classes. The coefficients representing each exposure are constrained to lie between 0 and 100 percent, and the sum of the effective exposures should be 100 percent. Equations (5.3) and (5.4) describe the constrained regression where selection returns are measured using the entire palette of fifteen indexes and $n$ = 10.[119] The binary variable, $\phi_i$, is 1 for all market indexes. Index returns include dividends and are sterling denominated. All factors are described in Table 5.2. As for the other two rolling window methodologies we back-fill the estimates of selection returns for the first three-years of data. Using data from month *t+36* to *t+1* to compute month *t* performance[120].

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[118] I thank Steve Hardy of Zephyr Associates, Inc. for making StyleADVISOR available at the London Business School.

[119] The rolling window methodologies using the entire palette of indexes allow for the fund to change exposure over time. If the manager, at time $t$, modifies the portfolio's holdings and the fund becomes exposed to a market, e.g. US, that outperforms in the following periods, the manager will receive credit for this successful rotation. At time $t$, the NAV returns are not adjusted for the performance of the US market because the factor loading corresponding to the S&P500, estimated using the returns from month $t$-36 to $t$-1, is zero. In the following periods this factor loading will gradually reflect the exposure to the US market.

The in-sample R-squared from this constrained regression procedure is bound to be lower than the corresponding value for unconstrained regression with the same indexes. However, the constrained coefficients may conform more closely to the investment policy of the funds. By imposing constraints on the coefficients, the out-of-sample fit may be improved.

### 3.4. The explanatory power of the different methodologies

The unconstrained and constrained multi-index methodologies provide a measure of managerial performance after adjusting for the fund's exposure. The importance of managerial performance estimates depends on the quality of the approach. This section compares the different methodologies in terms of in- and out-of-sample R-squared.

The seven-factor model, following Gruber's (1996) methodology, defines managerial performance as the alpha from a regression covering one-, two- or three-year periods. The quality of the approach can be measured by the in-sample R-squared. For the comparison with the three-year rolling window methodologies, we use the R-squared from the three-year regression. On the other hand, the rolling window methodologies use three years of data to determine the factor loadings and estimate managerial performance for the following period. The quality of these methodologies can be measured by the in- and out-of-sample R-squared[121]. The R-squared from the unconstrained regression is adjusted for degrees of freedom.

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[120] In section 4 below we consider the results including and excluding the back-filling period.

[121] The out-of-sample R-squared is defined as $R^2 = 1 - Var(Error)/Var(Asset)$ where Error is the selection return and Asset is the fund's NAV return.

The constraints that quadratic programming impose on the coefficients of the return-based style analysis are such that conventional tests of statistical significance cannot be used to evaluate the coefficients of the model. The overall quality of the approach, however, can be measured by the out-of-sample R-squared. Table 5.3 shows the in- and out-of-sample R-squared for each AITC fund category using the four methodologies. The results include the funds that disappeared during the period 1987-96; as noted earlier, 34 funds were unitised (open-ended), 56 were subject to a bid or merge and 4 were liquidated.

Table 5.3. The In- and Out-of Sample R-squared from the Unconstrained and Constrained Methodologies

Panels A and B show the in- and out-of-sample R-squared, respectively. Columns labelled Uncon 7 represent the R-squared for Gruber's (1996) seven-factor model, Uncon 9 for the rolling window unconstrained nine-factor model, Uncon 15 for the rolling window unconstrained approach using fifteen indexes and Constr 15 for the returns-base style analysis using fifteen indexes. The adjusted R-squared for the unconstrained methodologies are reported alongside. For each category of funds we define the R-squared as the equally-weighted average of the R-squared from the individual regressions. The three-year rolling window regressions use 36 months of data. On the other hand, Gruber's three-year unconstrained regression uses 144 weekly observations. The sample includes 338 closed-end funds over the period 1987-96.

| | Panel A In-sample R-squared | | | | | | | Panel B Out-of-sample R-squared | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Category | Uncon 7 | | Uncon 9 | | Uncon 15 | | Constr 15 | Uncon 9 | Uncon 15 | Constr 15 |
| | $R^2$ | Adj $R^2$ | $R^2$ | Adj $R^2$ | $R^2$ | Adj $R^2$ | $R^2$ | $R^2$ | $R^2$ | $R^2$ |
| International General | 0.82 | 0.81 | 0.85 | 0.81 | 0.92 | 0.86 | 0.83 | 0.38 | 0.35 | 0.59 |
| International Capital Growth | 0.66 | 0.65 | 0.78 | 0.71 | 0.88 | 0.80 | 0.74 | 0.21 | 0.20 | 0.53 |
| International Income Growth | 0.74 | 0.73 | 0.84 | 0.79 | 0.91 | 0.85 | 0.80 | 0.41 | 0.49 | 0.57 |
| UK General | 0.79 | 0.78 | 0.90 | 0.86 | 0.92 | 0.87 | 0.87 | 0.44 | 0.40 | 0.66 |
| UK Capital Growth | 0.67 | 0.65 | 0.74 | 0.66 | 0.84 | 0.73 | 0.66 | 0.27 | 0.27 | 0.51 |
| UK Income Growth | 0.87 | 0.87 | 0.94 | 0.92 | 0.95 | 0.92 | 0.93 | 0.64 | 0.59 | 0.74 |
| Smaller Companies | 0.67 | 0.65 | 0.86 | 0.81 | 0.90 | 0.83 | 0.81 | 0.28 | 0.22 | 0.58 |
| North America | 0.54 | 0.52 | 0.67 | 0.57 | 0.79 | 0.65 | 0.43 | 0.22 | 0.14 | 0.40 |
| Japan | 0.58 | 0.56 | 0.73 | 0.65 | 0.87 | 0.79 | 0.65 | 0.04 | 0.14 | 0.39 |
| Closed-End Funds | 0.49 | 0.47 | 0.76 | 0.69 | 0.83 | 0.72 | 0.74 | 0.29 | 0.21 | 0.59 |
| High Income | 0.70 | 0.69 | 0.84 | 0.79 | 0.88 | 0.80 | 0.79 | 0.35 | 0.20 | 0.49 |
| Continental Pan Europe | 0.57 | 0.55 | 0.66 | 0.56 | 0.77 | 0.62 | 0.63 | 0.07 | 0.01 | 0.37 |
| Far East excluding Japan | 0.40 | 0.31 | 0.61 | 0.49 | 0.76 | 0.60 | 0.49 | 0.02 | 0.10 | 0.29 |
| Far East including Japan | 0.62 | 0.57 | 0.78 | 0.71 | 0.91 | 0.85 | 0.72 | 0.10 | 0.20 | 0.43 |
| Unitised | 0.68 | 0.63 | 0.82 | 0.77 | 0.89 | 0.82 | 0.79 | 0.47 | 0.42 | 0.54 |
| Bid Merged | 0.49 | 0.41 | 0.69 | 0.60 | 0.78 | 0.64 | 0.59 | 0.02 | 0.04 | 0.43 |
| Liquidated | 0.40 | 0.32 | 0.64 | 0.54 | 0.71 | 0.52 | 0.54 | 0.18 | 0.00 | 0.40 |
| **All categories** | **0.63** | **0.60** | **0.77** | **0.70** | **0.85** | **0.76** | **0.71** | **0.26** | **0.23** | **0.50** |

The in-sample adjusted R-squared for the unconstrained methodologies increases with the number of indexes. As can be seen at the foot of Panel A, the overall sample average for the nine-factor model is 0.70 and the corresponding value for the fifteen-index model is 0.76. The seven-factor model uses the excess returns and style indexes expressed as differences. Compared to the nine-factor model that uses the same indexes, the in-sample fit is lower. The adjusted R-squared is 0.60. The average in-sample R-squared for the fifteen-indexes constrained methodology is 0.71, lower than the equivalent value for the fifteen-factor unconstrained model[122]. The result is consistent with Sharpe's (1992) observation that imposing constraints on the coefficients inevitably reduces the in-sample fit. However, as Sharpe points out, the rolling window procedure needs to be compared in terms of the out-of-sample R-squared.

Comparison of the two unconstrained approaches in Panel B shows that the nine-factor model does slightly better with out-of-sample data than the fifteen-factor model; the out-of-sample R-squared are 0.26 and 0.23, respectively. The nine-factor regression can be considered as a partially constrained approach where the loadings, $\beta_i$, on six market indexes are set equal to zero. This suggests that no important variable was omitted when we prespecified two of the geographical markets. The scope for improving out-of-sample R-squared by imposing restrictions is fulfilled if we introduce appropriate constraints. The interesting result, however, is that the constrained approach does much better out-of-sample than the unconstrained regressions. The R-squared of the returns-based style analysis is 0.50. Our conclusion is that the constrained approach defines a superior performance benchmark for our analysis. The other two rolling window unconstrained methodologies do not provide equally good out-of-sample performance benchmarks.

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[122] For our sample of 338 UK closed-end funds, we find that the Sharpe's (1992) return-based style analysis methodology has an average R-squared of 0.71 - 70 per cent of the funds have an R-squared above 0.75 and 90 per cent have an R-squared higher than 0.50. The results show that the fifteen-factor constrained model provides satisfactory estimates of asset mix for a very large sample of closed-end funds. Our results are consistent with Fung and Hsieh (1997). They run Sharpe's (1992) style regression for 3,327 open-end US mutual funds and find that 47 per cent of the funds have an R-squared above 0.75 and 92 per cent have an R-squared higher than 0.50.

The constrained approach needs now to be compared to Gruber's (1996) seven-factor model. The returns-based style analysis, as discussed earlier, does not suffer from some of the disadvantages of the unconstrained approach. The constrained regression restricts the factor loadings to be non-negative and, with its rolling window estimation, allows for the fund to change its exposure over time. However, the rolling window approach is less efficient in the sense that the relationship between NAV returns and factor returns is measured using a smaller number of observations. The seven-factor model is a simple methodology but it has an important drawback. The fact that managerial performance is defined as the intercept of the multi-index regression implies that the performance is measured with in-sample data. The approach does not capture the investor's expected returns since the measure of performance is not known until after the end of the research period. In the next section we present the results from Gruber's (1996) seven-factor regression alongside those from the return-based style analysis.

## 4. Empirical Results

Open-ended mutual funds are not traded companies but, instead, their size expands or contracts depending on investor demand. As a result, their price is equal to their NAV. Gruber (1996) suggests that because of this structure, the management of open-end funds is not priced, and he finds evidence of performance persistence in the US mutual fund industry. He shows that managers who have in the past been "good", tend also to outperform in the future, and investors can earn superior returns by investing in a portfolio of "well" managed funds. On the other hand, closed-end fund shares, fixed in number and traded, are systematically priced at a value which differs from NAV. Gruber (1996) argues that because the expectations of managerial performance are likely to be reflected in the share price, investors are unable to trade on the evidence of managerial performance persistence.

We define managerial performance using the two methodologies presented in the previous section: returns-based style analysis and the unconstrained seven-factor model. In contrast with Gruber's (1996) results, we find no evidence of managerial performance persistence in the UK closed-end fund market. In terms of the pricing of the funds, we also find no performance persistence in share price returns. Following Gruber's (1996) argument, if the expectations of managerial performance are incorporated in the fund's share price, discounts should reflect future managerial performance - well managed funds ought to trade at a smaller discount. The results provide no support for this hypothesis. Discounts do not seem to predict managerial performance.

Finally, we investigate the relationship between the fund's residual risk, measured by the variance of selection returns, and the discount. In the context of derivative hedging, the larger the basis risk, the less efficient is the arbitrage in driving prices towards fundamental values. The same principle may be applied in relation to closed-end funds. When basis risk is large, closed-end funds are priced as though there is an implied cost of arbitrage. The greater the difficulty of hedging, the larger the discount. We find evidence suggesting that higher residual risk portfolios are indeed associated with larger discounts.

### 4.1. Managerial performance persistence

Studies of performance persistence aim to determine whether investors would do better by choosing some funds rather than others. The literature has a strong focus on mutual funds. Gruber (1996) confirms the results of Hendricks, Patel and Zeckhauser (1993) and Goetzmann and Ibbotson (1994). All find evidence of persistence in mutual fund performance over relatively short horizons (one to three years). On the other hand, Grinblatt and Titman (1992) and Elton, Gruber, Das and Hlavha (1993) suggest the existence of persistence over periods of five to ten years into the future. Evidence of fund performance persistence is very extensive, but Carhart (1997) argues that persistence of returns can be attributed mainly to the difference in expenses charged. Much of the remaining persistence is driven by the one-year momentum effect of Jegadeesh and Titman (1993) and the consistent underperformance of worst-return mutual funds.

Using our sample of UK closed-end funds, we test the hypothesis of managerial performance persistence. Returns-based style analysis and Gruber's (1996) seven-factor model are used to define managerial performance. Equation (4.10) defines NAV total returns. The fund's dividend yield is added to NAV capital returns to obtain a measure net of management fees. Funds are ranked on the level of past performance and allocated to deciles. Past performance is measured over one-, two- and three-year periods. The risk-adjusted returns of the ten portfolios are then computed over the following one-year period, referred to as the performance period[123]. Table 5.4 shows the results with non-overlapping observations. The table also shows the difference between deciles and whether these differences are statistically significant - we use the Spearman rank correlation and t-tests. The Spearman rank correlation is a nonparametric test measuring the correlation between the ranks of the deciles and their average return over the subsequent performance period. To test the difference in means between top and bottom deciles (and quintiles), we calculate the t-statistic under the null hypothesis that the means are equal.

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[123] As explained in Chapter 4, one of the drawbacks of the Datastream database is the way that NAV is calculated. Every fund member of the AITC reveals its NAV monthly, or sometimes more frequently. During the period preceding the next announcement, the NAVs are estimated. Once the values are revealed, Datastream uses the new information to adjust past estimates. In order to avoid any bias introduced by this backward re-adjustment, we leave a one-month lag between the selection and the performance period.

Table 5.4. Managerial Performance Persistence

The risk-adjusted returns for the selection and the performance periods are measured using the returns-based style analysis approach and the unconstrained seven-factor model. Funds are ranked on past performance, measured over the selection period, and allocated to deciles at the beginning of each calendar year. The portfolios' returns - the equally-weighted average of the funds' risk-adjusted returns - are measured over the following one-year performance period. The results from the performance period are based on non-overlapping observations. Percentage selection and performance returns are measured with a month interval. Column Constrained 15 represents the annualised percentage cumulative selection returns using Sharpe's (1992) constrained methodology. The selection returns of each decile are cumulated over one-, two- and three-year performance periods. Column Unconstrained 7 shows the abnormal return from Gruber's (1996) unconstrained seven-factor model. For each decile we compute the performance period one-, two- and three-year alpha. Spearman rank correlation coefficients are also computed between the value of each decile's average performance and its rank. The sample includes 338 UK closed-end funds over the period 1987-1996. Significance levels are denoted by *** (1% level), ** (5% level) and * (10% level).

Panel A: Average Performance

| Decile of NAV performance over selection period | 1-year performance based on previous 1-year performance | | 1-year performance based on previous 2-year performance | | 1-year performance based on previous 3-year performance | |
|---|---|---|---|---|---|---|
| | Constrained 15 | Unconstrained 7 | Constrained 15 | Unconstrained 7 | Constrained 15 | Unconstrained 7 |
| 1 (Highest performance) | -0.3 | 3.2 | 0.0 | 1.7 | -4.4 | 1.9 |
| 2 | 1.5 | 1.1 | 2.0 | 2.1 | 1.2 | 3.5 |
| 3 | 0.9 | 1.0 | 1.3 | 3.7 | 0.7 | 1.1 |
| 4 | 0.8 | 1.3 | 1.3 | 2.2 | 2.4 | 1.4 |
| 5 | 0.9 | 0.3 | 1.1 | 1.2 | 1.4 | 1.4 |
| 6 | 0.0 | -0.2 | 1.6 | 2.8 | 1.1 | -0.6 |
| 7 | 0.7 | 1.8 | 0.3 | 1.3 | 2.4 | 1.5 |
| 8 | 0.2 | -2.2 | 0.2 | 0.9 | -0.5 | -1.4 |
| 9 | -0.2 | 0.0 | 0.0 | 0.3 | 1.3 | 0.5 |
| 10 (Lowest performance) | -0.3 | -1.1 | -0.9 | -1.0 | -1.8 | 0.0 |

Panel B: Rank Correlation Test and Diferences in Performance

| | | | | | | |
|---|---|---|---|---|---|---|
| Spearman Rank Coefficient | 0.41 | 0.71 ** | 0.58 * | 0.72 ** | -0.07 | 0.70 ** |
| Top - Bottom decile | -0.02 | 4.26 | 0.88 | 2.78 | -2.60 | 1.95 |
| Top - Bottom quintile | 0.84 | 2.70 | 1.44 | 2.29 | -1.34 | 2.47 |

The unconstrained multi-index approach might suggest the existence of performance persistence - the rank correlation coefficients for one-, two- and three year periods are all significant at the 5 percent level. The methodology cannot, however, provide a positive result in terms of the differences in the abnormal return of the top and bottom performing groups. Returns-based style analysis reveals no evidence of performance persistence. Neither the rank correlation coefficients nor the t-statistics for the test of the difference in selection returns of top and bottom performing groups are significant[124]. Top performing funds do not seem to outperform in the following period. We also measure performance persistence using equal length selection and performance periods (these results are available on request from the author) - on this basis, the conclusions are unchanged from those presented here using a one-year performance period.

The unconstrained methodology suffers severe look-ahead bias: an investor could not devise a portfolio strategy that generates this level of performance until after the sample period has ended. In particular, the methodology is based on the assumption that the asset mix is fixed. This could potentially fail to capture the risk attributes of the funds that change exposure over time and explain at least part of the difference in results between the two methodologies. The comparison of the two methodologies tends to suggest that the weak evidence of performance persistence using the seven-factor unconstrained regression reflects drawbacks in this approach. We conclude that there is no performance persistence in the UK closed-end fund market.

The weak evidence of performance persistence using the unconstrained seven-factor model is, of course, consistent with Gruber's (1996) finding of performance persistence in the US mutual fund industry. However, our UK evidence is much weaker and is not supported by the results from the returns-based style analysis methodology. A possible explanation for the different results in the two markets might be related to fees. We examine performance persistence after deduction of fees, while Gruber's (1996) study relates to gross, rather than net, performance. If good managers charge more, gross NAV persistence could disappear with our measure. On the other hand, if there is no NAV persistence, cross-sectional variation in the level of fees could induce the appearance of performance persistence.

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[124] Out of nine measures, one is significant at the 10 percent level, as would be expected by chance.

## 4.2. Share price performance persistence

Investors cannot buy or sell the fund shares at the NAV because closed-end funds systematically trade at a price which differs from NAV. The next step is to investigate share price performance persistence. Jegadeesh and Titman (1993) show that relative strength strategies - buying past winners and selling past losers - generate significant profits when returns are measured over three- to twelve-month periods. On the other hand, the contrarian literature shows that buying past losers and selling past winners earns abnormal returns over very short intervals (one week to one month, Jegadeesh (1990)).

Funds are ranked on the level of past performance, measured by total share price return, and allocated to deciles. Past performance is computed over one-, two- and three-year periods, referred to as the selection periods. The share price performance of the ten portfolios is then computed over the following one-, two- and three-year periods, referred to as performance periods. Selection and performance returns are measured with one month intervals to adjust for negative autocorrelation created by the bid/offer spread and thin trading. Table 5.5 shows no evidence of share price performance persistence.

Our evidence provides no support for the Jegadeesh-Titman momentum hypothesis. Past winners do not seem to do better than past losers[125]. On the contrary, performance measured over two and three years is characterized by a negative and significant rank correlation coefficient - past winners tend to do worse than past losers. When past performance is measured over two-year periods, the t-test tends to suggest that the difference between top and bottom deciles is statistically significant. The results are consistent with the evidence of price reversal discussed in Chapter 6.

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[125] The results for six-month periods (available from the author) also show no momentum in share price returns.

Table 5.5. Share Price Performance Persistence

Funds are ranked on past share price performance, measured over one-, two- and three-year selection periods, and allocated to deciles at the beginning of each calendar year. The portfolios' return - the equally-weighted average of the funds' share price performance - are measured over the following one-year performance period. The results from the performance period are based on non-overlapping observations. Percentage selection and performance returns are measured with a month interval. Spearman rank correlation coefficients are also computed between the value of each decile's average performance and its rank. The sample includes 338 UK closed-end funds over the period 1987-1996. Significance levels are denoted by *** (1% level), ** (5% level) and * (10% level).

Panel A: Average Share Price Performance

| Decile of share price performance over selection period | 1-year performance based on previous 1-year performance | 1-year performance based on previous 2-year performance | 1-year performance based on previous 3-year performance |
|---|---|---|---|
| 1 (Highest performance) | 12.15 | 9.78 | 7.27 |
| 2 | 13.94 | 8.86 | 7.82 |
| 3 | 11.89 | 11.29 | 12.15 |
| 4 | 13.67 | 12.17 | 11.93 |
| 5 | 11.67 | 13.27 | 12.85 |
| 6 | 11.57 | 13.00 | 9.62 |
| 7 | 12.07 | 13.86 | 10.81 |
| 8 | 13.96 | 10.81 | 10.50 |
| 9 | 15.21 | 17.22 | 13.67 |
| 10 (Lowest performance) | 17.81 | 17.87 | 16.21 |

Panel B: Rank Correlation Test and Diferences in Performance

| | | | |
|---|---|---|---|
| Spearman Rank Coefficient | -0.47 | -0.79 *** | -0.65 ** |
| Top - Bottom decile | -5.65 | -8.09 * | -8.94 |
| Top - Bottom quintile | -3.47 | -8.23 ** | -7.39 |

## 4.3. Discount as a predictor of managerial performance

The managerial performance theory suggests that discounts reflect the perception of managerial ability to perform relative to a passive investment strategy. In this section we revisit the hypothesis using a definition of managerial performance adjusted for the fund's asset exposure. The relationship between discounts and future managerial performance is investigated using the same ranking methodology. At the beginning of each calendar year, the 338 funds are allocated to deciles based on the level of their discounts. The performance of each decile is measured using both returns-based style analysis and the unconstrained seven-factor model. The portfolios are an equally-weighted average of the funds' performance. The hypothesis that discounts reflect future managerial performance implies that the small-discount portfolio (Decile 1) should earn a higher NAV return. Measuring two-and three-year performance of the portfolios constructed based on the discount level at the beginning of each calendar year, uses overlapping observations. To overcome the problem when interpreting the average results from the rankings we use non-overlapping sub-periods. For the two-year performance we test the relationship using, first, the odd rankings and then we repeat the procedure using even rankings. The table reports the average of the two series. For the three-year performance the results are the average of three series. The Spearman rank correlation coefficient and the test of the difference in risk-adjusted returns between the top and bottom deciles measures that relationship. Table 5.6 shows the results.

The unconstrained multi-index regression provides no support for the managerial performance theory that discounts reflect the expectations of future managerial performance. Neither the rank correlation coefficients nor the test for the difference in performance between top and bottom groups tend to suggest a positive and significant relationship between discounts and future managerial performance. The return-based style analysis approach confirms these results. There is no evidence that small discounts (high price to NAV ratios) are an indication of good future management performance[126].

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[126] The results are unchanged if we exclude the first 36 monthly rankings corresponding to the back-filled estimations of selection returns.

Table 5.6. Average Managerial Performance of the Top- and Bottom-Discount Portfolios.

Funds are ranked on the level of the discount and allocated, at the beginning of each calendar year, to deciles. The performance of the ten portfolios is measured using returns-based style analysis and the unconstrained seven-factor model. Column Constrained 15 represents the annualised percentage cumulative selection returns using the constrained methodology. For each decile, percentage selection returns are cumulated over one-, two- and three-year periods. Column Unconstrained 7 represents the annualised percentage abnormal return from Gruber's (1996) unconstrained seven-factor model. For each decile we compute the one-, two- and three-year alpha. To avoid the problem of overlapping observations when measuring performance over periods longer than one year, we create non-overlapping sub-series. For performance measured over two- and three-year periods, the table reports the average of two and three sub-series, respectively. Spearman rank correlation coefficients are also computed between the value of each decile's average performance and its rank. The sample includes 338 UK closed-end funds over the period 1987-1996. Significance levels are denoted by *** (1% level), ** (5% level) and * (10% level).

Panel A: Average Managerial Performance

| Decile of discount | 1-year performance based on discount | | 2-year performance based on discount | | 3-year performance based on discount | |
|---|---|---|---|---|---|---|
| | Constrained 15 | Unconstrained 7 | Constrained 15 | Unconstrained 7 | Constrained 15 | Unconstrained 7 |
| 1 (Largest premium)[•] | -1.0 | 0.4 | -1.3 | 0.0 | -0.7 | 0.3 |
| 2 | -1.6 | -1.5 | -0.9 | -0.2 | 0.5 | -0.9 |
| 3 | -0.3 | -0.2 | 0.0 | 0.5 | 1.0 | 1.2 |
| 4 | -1.1 | 0.6 | -0.5 | 1.6 | -0.3 | 0.5 |
| 5 | 1.3 | 0.8 | 1.6 | 1.9 | 1.5 | 1.2 |
| 6 | 2.0 | 0.3 | 1.0 | 0.8 | 1.2 | 0.5 |
| 7 | 0.4 | 1.0 | 1.4 | 1.0 | 1.4 | 0.5 |
| 8 | 0.9 | 1.1 | 1.0 | 2.1 | 1.1 | 2.1 |
| 9 | 0.1 | 2.1 | 0.8 | 1.8 | 1.0 | 0.7 |
| 10 (Largest discount) | -2.7 | -0.7 | 0.5 | 0.8 | 2.1 | 0.0 |

Panel B: Rank Correlation Test and Diferences in Performance

| | | | | | | |
|---|---|---|---|---|---|---|
| Spearman Rank Coefficient | -0.18 | -0.42 | -0.58 * | -0.58 * | -0.73 ** | -0.33 |
| Top - Bottom decile | 1.63 | 1.09 | -1.74 | -0.85 | -2.81 * | -0.33 |
| Top - Bottom quintile | -0.04 | -1.28 | -1.73 * | -1.43 | -1.66 | -1.00 |

[•] Largest premium / smallest discount

On the other hand when funds are ranked on *past* managerial performance, measured over one, two and three years, and allocated to deciles, the bottom performing portfolios tend to be characterised by larger discounts (low ratios of price to NAV). If the manager has performed poorly in the past, the fund will trade at a larger discount. The evidence, however, is not very strong, in particular when the performance is measured over one-year periods. Table 5.7 shows the results. The analysis of the relationship between discounts and managerial performance suggests that price weakly reflects past performance, but incorporates no expectations of future performance.

Table 5.7. Average Discount of the Top- and Bottom NAV Return Portfolios.

Funds are ranked on the level of past managerial performance, measured over one-, two- and three-year periods, and allocated to deciles at the beginning of each calendar year. The table shows the percentage discount of each decile. The discounts are the logarithm of an equally-weighted average of the funds' price to NAV ratios. Spearman rank correlation coefficients are also computed between the value of each decile's average discount and its rank. The sample includes 338 UK closed-end funds over the period 1987-1996. Significance levels are denoted by *** (1% level), ** (5% level) and * (10% level).

Panel A: Average Discount

| Decile of NAV performance over selection period | Discount based on 1-year performance | | Discount based on 2-year performance | | Discount based on 3-year performance | |
|---|---|---|---|---|---|---|
| | Constrained 15 | Unconstrained 7 | Constrained 15 | Unconstrained 7 | Constrained 15 | Unconstrained 7 |
| 1 (Highest performance) | -13.8 | -12.5 | -11.1 | -12.0 | -11.3 | -10.9 |
| 2 | -12.4 | -12.9 | -12.5 | -10.9 | -9.3 | -11.1 |
| 3 | -10.9 | -12.1 | -9.3 | -12.4 | -10.2 | -11.6 |
| 4 | -13.4 | -14.7 | -11.6 | -13.7 | -10.4 | -11.4 |
| 5 | -12.5 | -14.9 | -13.0 | -14.7 | -11.3 | -11.8 |
| 6 | -13.7 | -14.2 | -11.3 | -14.8 | -10.4 | -13.2 |
| 7 | -13.2 | -14.9 | -12.8 | -12.4 | -12.0 | -13.4 |
| 8 | -14.7 | -13.8 | -12.3 | -15.4 | -11.0 | -14.7 |
| 9 | -12.7 | -14.8 | -11.6 | -18.3 | -13.0 | -16.4 |
| 10 (Lowest performance) | -16.3 | -20.2 | -15.7 | -19.5 | -15.3 | -23.4 |

Panel B: Rank Correlation Test and Diferences in Discount

| | | | | | | |
|---|---|---|---|---|---|---|
| Spearman Rank Coefficient | 0.44 | 0.73 ** | 0.54 * | 0.92 ** | 0.70 ** | 0.99 *** |
| Top - Bottom decile | 2.51 | 7.69 ** | 4.67 ** | 7.53 * | 3.99 * | 12.46 ** |
| Top - Bottom quintile | 1.38 * | 4.82 ** | 1.86 | 9.44 ** | 3.83 ** | 8.88 ** |

## 4.4. Residual risk and cost of arbitrage

Empirical evidence shows that closed-end funds systematically trade at a share price that differs from NAV. If there is a cost to arbitrage, the difficulty of hedging determines the arbitrage profitability and the magnitude of the mispricing. Pontiff (1996) shows that, in the US closed-end fund market, the share price is more likely to deviate from NAV for funds that are characterised by higher specific risk. He measures the unhedgeable risk by the volatility of the residuals from regressing NAV returns on a set of assets.

Returns-based style analysis defines selection returns as the difference between the fund NAV return and the return on a passive portfolio with the same style of the fund. We measure the fund's residual risk as the volatility of the selection returns. If there is a cost to arbitrage, the fund's price can be expected to deviate from the sum of the NAV and the "correct" discount. Therefore, if it is difficult to hedge - the residual risk is high - we can expect more extreme discounts. That is, when the price is too high, arbitrage fails to push closed-end prices to the appropriate levels.

Using the returns-based style analysis approach we rank the funds on residual risk measured over one-, two- and three-year periods and construct ten portfolios. Funds are ranked at the beginning of each calendar year. The absolute value of each decile's discount[127] is then computed as at the start of the following year. Table 5.8 (Panel A) shows the results. Both the rank correlation coefficients and the test for the difference in residual risk between top and bottom groups tend to suggest that high-residual risk portfolios are associated with large discounts. The higher the residual risk, the higher is the absolute value of the discount. The results confirm Pontiff's (1996) evidence.

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[127] The absolute value of the discount is defined as $| d_t | = | \ln (P_t / NAV_t) |$, where $P_t$ and $NAV_t$ are the share price and the net asset value of the closed-end fund, respectively. As discussed in Chapter 4, the average discount of the decile is the logarithm of 1 plus the equally-weighted average of the absolute value of the price to NAV ratio minus 1.

Table 5.8. Absolute Discount and Residual Risk

Panel A: Funds are ranked on the level of residual risk, measured by the monthly selection return standard deviation, and allocated to deciles at the beginning of each calendar year. Decile 1 corresponds to the highest residual risk. The volatility of the selection returns is measured over one-, two- and three-year periods. The table shows the percentage absolute value of each decile's discount. The average discount of the decile is the logarithm of 1 plus the equally-weighted average of the absolute value of the price to NAV ratio minus 1. Panel B: Funds are ranked on the level of the discount absolute value and allocated to deciles at the beginning of each calendar year. Decile 1 corresponds to the largest discount absolute value. The residual risk, defined as the selection return standard deviation, of the ten portfolios is measured over one-, two- and three-year periods. The portfolios are the equally-weighted average of the funds' residual risk. Panel B shows the results expressed as the percentage of selection return volatilities. To avoid the problem of overlapping observations when measuring selection returns over periods longer than one year, we create non-overlapping sub-series. For selection returns measured over two- and three-year periods, the table reports the average of two and three sub-series, respectively. The table reports the results from the test of the difference between the top and bottom deciles alongside the Spearman rank correlation coefficients. The sample includes 338 UK closed-end funds over the period 1987-1996. Significance levels are denoted by *** (1% level), ** (5% level) and * (10% level).

| | Panel A: Deciles based on Residual risk | | | Panel B: Deciles based on Discount | | |
|---|---|---|---|---|---|---|
| Decile of ranking variable | Discount based on 1-year res risk | Discount based on 2-year res. risk | Discount based on 3-year res risk | Residual risk in following 1 year | Residual risk in following 2 years | Residual risk in following 3 years |
| 1 (High) | 14.1 | 13.8 | 12.0 | 3.10 | 2.90 | 2.83 |
| 2 | 12.8 | 12.8 | 11.9 | 2.49 | 2.45 | 2.31 |
| 3 | 12.5 | 12.1 | 11.7 | 1.83 | 1.71 | 1.67 |
| 4 | 14.7 | 12.6 | 13.2 | 1.82 | 1.90 | 1.95 |
| 5 | 11.9 | 12.8 | 11.2 | 1.81 | 1.72 | 1.70 |
| 6 | 12.4 | 11.4 | 10.0 | 1.98 | 1.97 | 2.05 |
| 7 | 12.4 | 10.6 | 10.4 | 1.91 | 1.94 | 1.91 |
| 8 | 12.3 | 11.9 | 10.5 | 1.94 | 1.94 | 1.83 |
| 9 | 11.6 | 11.4 | 11.0 | 2.00 | 2.05 | 1.94 |
| 10 (Low) | 12.2 | 11.6 | 11.4 | 2.17 | 2.17 | 2.27 |

Panel C: Rank Correlation Test and Differences in Discount and Residual Risk

| | | | | | | |
|---|---|---|---|---|---|---|
| Spearman Rank Coeff. | 0.78 *** | 0.72 ** | 0.62 * | 0.07 | 0.04 | 0.22 |
| Top - Bottom decile | 1.87 ** | 2.23 ** | 0.57 | 0.93 ** | 0.72 ** | 0.56 |
| Top - Bottom quintile | 1.47 * | 1.92 * | 0.74 | 0.71 ** | 0.56 * | 0.47 * |

The level of funds' residual risk tends to be relatively stable (Dimson and Marsh (1983)), so we would expect the relationship between residual risk and discount to be persistent over time. To check this, we look at using the discount as a predictor of subsequent levels of residual risk. Ranking the funds on the absolute value of the discount and measuring the residual risk of the deciles shows the same relationship between funds' risk and their discount. Large-discount portfolios are associated with high residual risk. Table 5.8 (Panel B) shows the results for residual risk measured over one-, two- and three-year periods. The results show that the relationship between discounts and future residual risk is not as strong as between discounts and past residual risk, in particular in terms of the rank correlation coefficient. This suggests that discounts tend to reflect past rather than future unhedgeable risk.

## 5. Conclusion

This chapter revisits one of the traditional theories of the discount - managerial performance - which claims that discounts reflect the perception of management ability to perform relative to a passive portfolio. The fact that discounts do not seem to be positively correlated to future NAV returns may explain why so few studies have looked at managerial performance. However, prior tests have focused on raw estimates of NAV returns, and have limited power. The literature implies either that the relationship between discounts and managerial performance does not exist, or that the power of tests based on NAV returns is too low.

The objective of this chapter was to rectify the weakness of using the return on NAV as the definition of managerial performance. We measure performance after adjusting for the risk and factor exposures of the fund. To define the value added by active management we use two methodologies - the unconstrained and the constrained multi-index regression. The first approach follows Gruber (1996) and defines performance as the intercept of a multi-index unconstrained regression. Within the unconstrained framework we also use a three-year rolling window to measure monthly abnormal returns. The unconstrained methodology defines fund exposures based on the asset mix held at a particular period of time. Choosing the set of indexes which most closely reflect the investment policy of the trust does not allow for the fund to change exposure over time. Therefore, we replicate the results from the rolling window methodology using the entire palette of indexes and compare the adjusted R-squared. The alternative approach is Sharpe's (1992) returns-based style analysis, in which factor loadings are constrained to be non-negative and add to unity. The unconstrained and constrained regressions provide measures of managerial performance. The comparison of the different methodologies shows that the constrained approach does much better out-of-sample than the rolling window unconstrained regressions. We define managerial performance using Gruber's (1996) seven-factor model and Sharpe's (1992) returns-based style analysis.

Using our sample of UK closed-end funds, we find weak evidence of performance persistence using the seven-factor unconstrained regression. This is consistent with Gruber's (1996) conclusion in his Presidential Address on performance persistence in the US mutual fund industry. However, our evidence is much weaker, and is not supported by the results from the returns-based style analysis. The comparison of the two methodologies tends to suggest that the weak evidence of persistence using the seven-factor model results from drawbacks in the unconstrained regression approach. Consequently, we conclude that there is no performance persistence in the UK closed-end fund market.

Closed-end funds are systematically priced at a value that differs from NAV. In terms of their pricing, we find no evidence of share price performance persistence. On the contrary, there is evidence of price reversal. Gruber (1996) argues that the price of closed-end funds should incorporate the expectations of managerial performance. We find that discounts weakly reflect past performance, but do not seem to predict performance. The results tend to suggest that practitioners might be wrong in believing that discounts reflect future managerial performance.

Finally we test the hypothesis that a fund's residual risk affects the discount. Pontiff (1996) shows that funds with large unhedgeable risk trade at higher discounts. We confirm his results, defining residual risk as the variance of selection returns. The greater the difficulty of hedging - as measured by each fund's residual risk - the higher the discount. This relationship also holds when we use discounts as a predictor of residual risk in subsequent test periods.

# Chapter 6

# Time-Series Behaviour of UK Closed-End Fund Discounts

## 1. Introduction

This chapter investigates the time-series behaviour of UK closed-end fund discounts and extends research previously carried out for the US market. We attempt to characterise the discounts in terms of autocorrelation, stationarity, mean-reversion and cointegration. The idea is to identify the factors that might drive the model of the discount generating process to be analysed in Chapter 7.

The analysis shows that discounts are highly autocorrelated in their levels but not in their first differences. Nevertheless, we find weak evidence of price reversal. We also show that UK closed-end fund discounts have a tendency to revert to their mean and fluctuate around it within a certain range. Furthermore, there is strong evidence of UK closed-end fund discounts moving together.

## 2. Data Description

For the entire UK closed-end fund industry, Datastream provides share price and undiluted NAV with prior charges valued at par. Discounts are computed using monthly data from January 1980 to March 1997. See Section 2 of Chapter 4 for the definition of the discount.

We investigate almost the entire UK investment trust industry, with the exception of funds that invest in unquoted securities (Venture & Development), specialist funds (Commodity & Energy and Property), Emerging Market funds and Split Capital trusts[128]. The fourteen categories[129] under investigation cover 244 funds. Table 2.1 describes the categories and Table 6.1 below details the individual funds. Some of the results are based on the International General category (general investment trust companies with less than 80 percent of their assets invested in any geographical area). Although there are only 17 funds in this category, they are major players in the sector[130].

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[128] This study does not investigate in detail the Split Capital Trusts category. Nevertheless, some of the funds are included in other categories; in our 244-fund sample, 17 of the funds are also Split Capital Trusts (see Section 4 of Chapter 2 for the computation of discount/premium on Split Capital funds).

[129] Because of their small number and similarity to the funds in the Continental Europe category, we include the three funds of the Pan Europe category in the Continental Europe category.

[130] 80 per cent of the International General funds are included in the FTSE-All share index, whereas only 40 per cent of all the investment trusts are part of the index. Furthermore, the International funds represent 10 per cent of the number of investment trusts included in the index, but 28 per cent in terms of market capitalisation.

Table 6.1. UK Closed-End Funds - March 1997

The table details the funds in each AITC category and their management group. An asterisk indicates a split-capital fund.

| Funds | Management Group | Funds | Management Group |
|---|---|---|---|
| 1 **International General** | | 4 **UK General** | |
| Alliance Trust | Independent | Albany Inv Trust | Independent |
| Bankers Inv Trust | Henderson Investors | British & American It | Independent |
| Baring Tribune | Baring Private | Edinburgh Inv Trust | Edinburgh Fund Managers |
| British Inv Trust | Edinburgh Fund Managers | Foreign & Colonial Pep Inv Tst. | Foreign&Colonial |
| Brunner Inv Tst. | Kleinwort Benson | * Foreign & Colonial Spc Utils | Foreign&Colonial |
| Foreign & Colonial | Foreign&Colonial | Finsbury Growth Tst. | Finsbury |
| Law Debenture | Independent | Finsbury Trust | Finsbury |
| Majedie Invs | Independent | Fleming Claverhouse | Fleming |
| Mid Wynd Intl | Baillie Gifford | * Friends Provident Ethical | FP |
| Personal Assets | Independent | * Gart.Scotland | Gartmore |
| Scottish American | Stewart Ivory | Govett Strategic | Govett (John) |
| Scottish Eastern | Martin Currie | * Guinness Flight Extra Income | Guinness Flight |
| Scottish Mortgage | Baillie Gifford | Inv Tst.Guernsey | 3i |
| Scottish Inv | Independent | * Jupiter Split | Jupiter |
| Second Alliance | Independent | Malvern Uk Index Tst | Edinburgh Fund Managers |
| Value Realisation Tst. | Rothschild (J) | Mercury Keystone | Mercury |
| Witan Inv Co | Henderson Investors | Welsh Industrial It | Independent |
| | | | |
| 2 **International Capital Growth** | | 5 **UK Capital Growth** | |
| Anglo & Overseas | Morgan Grenfell | Asset Management Inv Co | Independent |
| Baring Stratton | Baring Private | Broadgate It | ICE |
| British Empire Secs | Ivory&Sime | Fidelity Spc Values | Fidelity |
| Commercial Union Erw | Commercial Union | Fleming Enterprise | Fleming |
| Dunedin Worldwide | Edinburgh Fund Managers | Ivory & Sime Isis Trust | Ivory&Sime |
| Electric & General | Henderson Investors | Kleinwort Endowment | Kleinwort Benson |
| English & Scottish | Gartmore | Klein.2Nd Endowment | Kleinwort Benson |
| Finsbury Technology | Finsbury | Legal & General Recovery | Legal&General |
| Finsbury Wwd.Pharm. | Finsbury | Life Offices Opps | Scottish Value |
| Fleming Overseas | Fleming | * M&G Recovery | M&G |
| Govett Global Smcos | Govett (John) | Pictet British Inv Co | Pictet UK |
| Greenfriar | Henderson Investors | Schroder Uk Growth | Schroder |
| Henderson Technology | Henderson Investors | Taverners Trust | Abtrust |
| * Jupiter International Green | Jupiter | Undervalued Assets | Scottish Value |
| Kleinwort Overseas | Kleinwort Benson | | |
| Monks Inv Trust | Baillie Gifford | 6 **UK Income Growth** | |
| Murray Smaller Mkts | Murray Johnstone | Dunedin Inc Growth | Edinburgh Fund Managers |
| Overseas Inv | Morgan Grenfell | Foreign & Colonial Income Growth | Foreign&Colonial |
| Primadona | Jupiter | * Fleming Income & Capital | Fleming |
| Ptarmigan International | Stewart Ivory | * Gartmore British Income & Growth | Gartmore |
| RIT Capital Partners | Rothschild (J) Capital | GT Income Growth | LGT |
| * TR Technology | Henderson Investors | Investors Capital | Ivory&Sime |
| Updown Inv | Cazenove Fund Management | Lowland Inv | Henderson Investors |
| Warrants & Value | Scottish Value | * M&G Equity | M&G |
| | | * M&G Income | M&G |
| 3 **International Income Growth** | | Merchants Trust | Kleinwort Benson |
| British Assets | Ivory&Sime | Morgan Grenfell Equity Income | Morgan Grenfell |
| * Fleming Worldwide | Fleming | Murray Income | Murray Johnstone |
| Murray International | Murray Johnstone | Perpetual Income & Growth | Perpetual |
| Securities Trust of Scotland | Martin Currie | Prolific Income | Prolific |
| | | Schroder Income Gw | Schroder |
| | | Temple Bar | Guinness Flight |
| | | TR City Of London | Henderson Investors |
| | | Value & Income | OLIM |

Table 6.1. UK Closed-End Funds - March 1997 (Cont'd)

| Funds | Management Group |
|---|---|
| 7 **High Income** | |
| Abtrust Convertible Income | Abtrust |
| Abtrust High Income | Abtrust |
| Bzw Convertible | Barclays Global |
| Cairngorm Building Societies | Cairngorm (JP) |
| City Merchant High Yield | INVESCO Private Portfolio |
| Dartmoor Inv Tst. | Exeter Asset Management |
| Geared Income Trust | Broker Financial Services |
| Glasgow Income | Glasgow Investment Managers |
| Govett High Income | Govett (John) |
| Henderson Highland | Henderson Investors |
| Invesco Convertible | INVESCO |
| * Olim Convertible | OLIM |
| Shires Income | Glasgow Investment Managers |
| TR High Income | Henderson Investors |
| 8 **Closed-End Funds** | |
| Benfield & Rea | Rea Brothers |
| Capital Gearing Tst. | Cazenove Fund Management |
| Exeter Preferred Capital | Exeter Asset Management |
| Inv Tst Of Inv Trusts | Jupiter |
| London & St.Lawrence | Independent |
| New City & Commercial | INVESCO |
| Scottish Value | Scottish Value |
| World Trust Fund | Lazard Freres |
| 9 **Smaller Companies** | |
| 3i Sm.Quoted Cos Trust | 3i |
| Aberforth Smaller companies | Aberforth |
| * Aberforth Split Level | Aberforth |
| Amicable Smaller Ents | Scottish Amicable |
| Beacon Inv Trust | Rutherford |
| Dunedin Smaller Cos | Edinburgh Fund Managers |
| Eaglet Inv Tst. | Rutherford |
| Edinburgh Smcos It. | Edinburgh Fund Managers |
| Foreign & Colonial Smaller Cos | Foreign&Colonial |
| Fleming Fledgeling | Fleming |
| Fleming Mercantile | Fleming |
| Fleming Smaller Cos | Fleming |
| Framlington 1000 Smcos | Framlington |
| Gartmore Micro Index | Gartmore |
| Gartmore Smaller Cos | Gartmore |
| Group Trust | Legal&General Ventures |
| Henderson Strata | Henderson Investors |
| Herald Inv Tst | Herald |
| Hill Samuel Uk Emrg. | Hill Samuel |
| Hoare Govett Smcos | Broadgate |
| Hoare Govett 1000 Idx. | Broadgate |
| Ivory & Sime UK Discovery | Ivory&Sime |
| Ivory & Sime Uk Smaller Cos | Ivory&Sime |
| Intl Biotechnology | Rothschild |
| Invesco Eng.& Intl | INVESCO |
| Invesco Enterprise | INVESCO |
| Kleinwort Smaller Cos. | Kleinwort Benson |
| * Lloyds Smaller Companies | Hill Samuel |
| Montanaro Uk Smcos. | Montanaro |
| Moorgate Inv | Martin Currie |
| **Smaller Companies (Cont'd)** | |
| Moorgate Smaller Cos Income | Martin Currie |
| Murray Enterprise | Murray Johnstone |
| Natwest Smaller Cos | Gartmore |
| Perpetual UK Smcos. | Perpetual |
| Pilot Inv Tst. | Rutherford |
| Saracen Value Tst. | SFM |
| Shires Smaller Cos | Glasgow Investment Managers |
| Smaller Companies It. | Abtrust |
| St.Andrew Trust | Martin Currie |
| The Knox D'Arcy Tst. | Knox D'Arcy |
| Throgmorton Preferred Income | Scottish Value |
| Throgmorton Trust | Framlington |
| TR Smaller Companies | Henderson Investors |
| 10 **North America** | |
| American Oppor Tst. | Hambro (J O) |
| American Trust | Edinburgh Fund Managers |
| Canadian General Inv | Maxwell Meighen & Associates |
| Foreign & Colonial US Smaller Cos | Foreign&Colonial |
| Fleming American | Fleming |
| Govett Amer Smcos | Govett (John) |
| Healthcare Reform Tst. | HealthReform Partners Inc |
| North Atlantic Smcos | Hambro (J O) |
| Renaissance US Gw & Inc | Renaissance Capital Group Inc |
| Second London American | Hambrecht & Quist |
| US Smaller Companies | Wellington |
| 11 **Far East: excluding Japan** | |
| Abtrust Asian Smcos. | Abtrust |
| Abtrust Emerging Asia | Abtrust |
| Abtrust New Dawn | Abtrust |
| Abtrust New Thai | Abtrust |
| Australian Opps | Ingot Capital |
| Edinburgh Dragon Tst. | Edinburgh Fund Managers |
| Edinburgh New Tiger | Edinburgh Fund Managers |
| Edinburgh Java | Edinburgh Fund Managers |
| Fidelity Asian Values | Fidelity |
| First Philippine | Jupiter |
| Gartmore Emrg Pacific | Gartmore |
| Govett Asian Smcos. | Govett (John) |
| Hambros Sm.Asian | Hambros |
| Invesco Asia Trust | INVESCO |
| Invesco Korea | INVESCO |
| Korea Asia Fund | Korea Asia |
| Korea Europe Fund | Schroder |
| New Zealand Inv | Exeter Asset Management |
| Pacific Assets | Ivory&Sime |
| Pacific Horizon | Baillie Gifford |
| Scottish Oriental Smcos | Stewart Ivory |
| Scottish Asian | Murray Johnstone |
| Schroder AsiaPacific | Schroder |
| Schroder Korea Fund | Schroder |
| Siam Selective Growth | Management International (Guernsey |
| Singapore Sesdaq Fund | Govett (John) (Jersey) |
| Taiwan Inv Tst. | Jupiter |
| Tea Plantations Inv.Tst | Regent (UK) |
| TR Pacific | Henderson Investors |

Table 6.1. UK Closed-End Funds - March 1997 (Cont'd)

| Funds | Management Group | Funds | Management Group |
|---|---|---|---|
| 12 **Far East: including Japan** | | 14 **Continental Europe** | |
| Asia Healthcare | Lloyd George | Abtrust European Index | Abtrust |
| Foreign & Colonial Pacific | Foreign&Colonial | Continental Assets | Ivory&Sime |
| Fleming Far Eastern | Fleming | European Assets Tst. | Ivory&Sime |
| Govett Oriental | Govett (John) | Foreign & Colonial Eurotrust | Foreign&Colonial |
| Martin Currie Pacific | Martin Currie | Foreign & Colonial German | Foreign&Colonial |
| TR Far East Income | Henderson Investors | Fidelity Eur Values | Fidelity |
| | | First Ireland | AIB |
| 13 **Japan** | | Fleming Cont Europe | Fleming |
| Atlantis Japan Growth | Atlantis | Fleming Eur Fledge | Fleming |
| Baillie Giff Japan | Baillie Gifford | Gartmore European | Gartmore |
| Baillie Shin Nippon | Baillie Gifford | German Inv.Tst. | Hill Samuel |
| Edinburgh Japan | Edinburgh Fund Managers | German Smaller Cos | Hill Samuel |
| Fidelity Japanese Values | Fidelity | * Henderson Eurotrust | Henderson Investors |
| Fleming Japanese | Fleming | Martin Currie Eur | Martin Currie |
| Gartmore Select Japanese | Gartmore | Murray European | Murray Johnstone |
| GT Japan | LGT | NatWest Irish Smcos | Gartmore |
| HTR Japan Smcos | Henderson Investors | Paribas French Inv | Paribas |
| Invesco Japan Dsy | INVESCO | Second Market Inv Co | Lombard Odier |
| Invesco Tokyo Trust | INVESCO | TR European Growth | Henderson Investors |
| JF Fledgeling Japan | Jardine Fleming | Voyageur Eur Smcos. | Voyager International |
| JF Japan Otc | Jardine Fleming | | |
| Martin Currie Japan | Martin Currie | 15 **Pan Europe** | |
| Perpetual Japanese | Perpetual | European Smaller Cos | Thornton |
| Schroder Japan Growth | Schroder | Kleinwort Charter | Kleinwort Benson |
| | | Mercury Eur Pvtn. | Mercury |

Source: NatWest Securities (January 1997).

## 3. Summary Statistics

As illustrated in Figure 2.1, the discount on UK closed-end funds gradually narrowed from an average of 33.5 percent at the beginning of the 1980s to approximately 5 percent in 1994. The trend then started to reverse and the average discount is currently around 13 percent. Panel A of Table 6.2 shows the average discount of the 244-fund sample over the period 1980 to 1997, measured both as an equally-weighted and market value weighted average. The trend for the market value weighted average discount shows a similar narrowing during the period 1980-1994 to the equally-weighted measure. For most years, the market value weighted average discount is larger than the equally-weighted value. The results suggest that large funds tend to be characterised by higher discounts.

Table 6.2. Average Discount and Closed-End Funds' Volatility

Panel A shows the percentage average discount of the 244-fund sample over the period 1980-1997. The equally-weighted average discount is defined as the logarithm of the equally-weighted average price to NAV ratios. The market value weighted discount is the logarithm of the market value weighted average price to NAV ratios. Discounts are measured at the beginning of each calendar year. Panel B shows the annualised monthly volatilities (standard deviations) of discount changes, share price total returns and NAV total returns. Monthly volatilities are measured over one-year periods and then annualised (by multiplying by $\sqrt{12}$ ). Excess volatility is measured as the ratio of the variance of share price returns to the variance of NAV returns, minus 1. The results in Panel B are the percentage average for the 244-fund sample. We use monthly data from January 1980 to December 1997.

| | Panel A : Average Discount | | Panel B : Annualised monthly volatility | | | |
|---|---|---|---|---|---|---|
| | Equally-weighted average discount | MV weighted average discount | Discount changes | Price total return | NAV total return | Excess volatility |
| 1980 | -33.52 | -37.37 | 13.29 | 23.42 | 17.74 | 74.26 |
| 1981 | -25.29 | -27.95 | 14.54 | 24.62 | 18.91 | 69.43 |
| 1982 | -29.90 | -33.25 | 15.62 | 19.54 | 13.96 | 96.13 |
| 1983 | -27.40 | -29.97 | 15.71 | 17.32 | 13.24 | 70.96 |
| 1984 | -23.84 | -26.72 | 13.10 | 22.71 | 16.28 | 94.56 |
| 1985 | -23.83 | -27.23 | 13.98 | 17.71 | 13.92 | 61.87 |
| 1986 | -21.57 | -24.42 | 16.83 | 18.97 | 14.01 | 83.40 |
| 1987 | -18.89 | -20.64 | 20.51 | 44.44 | 39.12 | 29.05 |
| 1988 | -20.34 | -25.42 | 13.62 | 17.75 | 13.82 | 65.08 |
| 1989 | -18.92 | -22.16 | 12.82 | 19.30 | 14.27 | 82.96 |
| 1990 | -11.82 | -15.10 | 15.99 | 24.39 | 20.31 | 44.22 |
| 1991 | -13.46 | -13.69 | 15.03 | 22.86 | 16.54 | 91.09 |
| 1992 | -11.16 | -11.13 | 16.12 | 24.96 | 21.97 | 29.13 |
| 1993 | -12.38 | -11.59 | 13.11 | 17.66 | 13.29 | 76.65 |
| 1994 | -5.15 | -5.53 | 13.16 | 18.34 | 15.11 | 47.32 |
| 1995 | -6.96 | -6.85 | 10.38 | 14.67 | 11.60 | 59.90 |
| 1996 | -9.61 | -8.58 | 10.83 | 13.95 | 12.04 | 34.12 |
| 1997 | -11.72 | -12.17 | 11.96 | 18.49 | 17.22 | 15.36 |
| **Average** | **-18.10** | **-19.99** | **14.26** | **21.17** | **16.85** | **57.84** |

In conjunction with the general decline in the average level of discounts, the volatility of discount first differences slightly decreased, in particular during the 1990s. Panel B of Table 6.2 shows the annualised monthly volatility (standard deviation) of discount first differences measured over one-year periods. Panel B also describes the annualised monthly volatility of share price and NAV total returns. Our measure of excess volatility - the ratio of the variance of share price returns to the variance of NAV returns - indicates that, on average, the variance of UK closed-end fund returns is 58 percent greater than the variance of portfolio returns. The evidence is consistent with Pontiff's (1997) analysis. He shows that US closed-end fund monthly returns are 64 percent more volatile than their assets.

A characterisation of the degree of price reversal in the closed-end fund market is the average correlation of discount annual first differences. For each fund in our sample we calculate the annual changes in the discount. We then measure the correlation between discount changes over consecutive periods as follows:

$$correlation_t = \rho\,(\Delta disc_{t-1/t}\,;\ \Delta disc_{t\ t+1}) \qquad (6.1)$$

where $\Delta disc_{t-1\,t}$ is the annual change in the discount from January of year $t$-$1$ to January of year $t$ and $\Delta disc_{t/t+1}$ is the annual change in the discount from January of year $t$ to January of year $t+1$. Table 6.3 shows the correlation coefficients as well as the value of the $t$ statistics based on our 244-fund sample.

Table 6.3. Correlation of Discount Annual Changes

Discount annual first differences are computed for each of the 244 funds in our sample. Discounts are measured at the beginning of each calendar year over the period January 1980 to December 1997. The correlation between discounts annual changes is then computed for consecutive periods. The time $t$ correlation coefficient corresponds to the correlation between the annual changes from January of year $t$-$1$ to January of year $t$ and annual changes from January of year $t$ to January of year $t+1$. In brackets are the values of the t-statistics for the correlation coefficients.

| Year | Correlation | t-statistic |
|---|---|---|
| 1980 | | |
| 1981 | -0.22 | (-3.62) |
| 1982 | -0.48 | (-8.69) |
| 1983 | -0.27 | (-4.43) |
| 1984 | -0.10 | (-1.60) |
| 1985 | 0.04 | (0.62) |
| 1986 | -0.12 | (-1.94) |
| 1987 | -0.46 | (-8.22) |
| 1988 | -0.54 | (-10.10) |
| 1989 | -0.10 | (-1.52) |
| 1990 | -0.41 | (-7.03) |
| 1991 | -0.10 | (-1.63) |
| 1992 | -0.25 | (-4.02) |
| 1993 | -0.39 | (-6.71) |
| 1994 | -0.28 | (-4.58) |
| 1995 | -0.16 | (-2.56) |
| 1996 | -0.17 | (-2.76) |
| 1997 | -0.10 | (-1.53) |
| **Average** | -0.24 | (-4.14) |

The results show that discount annual changes are, on average, negatively correlated over the sample - the correlation coefficient of -0.24 is significant at the 1 percent level[131].

## 4. Autocorrelation of the discount

The autocorrelation analysis is the first step in characterising the behaviour of the discount. We start by investigating the autocorrelation process of the average discount of each category. Discounts are expressed as levels. Panel A of Table 6.4 shows the average results for all fourteen categories. Using monthly data, the average first-order autocorrelation is about 0.93 and decays to 0.64 for the twelfth-order autocorrelation. The t-statistics[132] for all-order autocorrelation coefficients in discount levels are highly significant. The results show that current discount levels contain information about future discounts. The first-order autoregressive process can explain 86.5 percent of the discount variation for a fund with average autocorrelation.

Evidence that discounts are highly autocorrelated in their levels is not very surprising. Discounts tend not to change considerably from one period to the next. What is more important is to investigate the behaviour of discount first differences. Panel B of Table 6.4 shows the result of the first- to twelfth-order autocorrelation. The first order autocorrelation coefficient is characterised by a negative coefficient, -0.18, which is significant at the 1 percent level. Monthly changes in the discount can explain, on average, 3.2 percent of the variance of changes during the following month. However, the coefficients are insignificant for all higher order autocorrelations in discount first differences.

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[131] The average t-statistic of the correlation coefficients is also significant at the 1 per cent level (t-statistic value of -4.30).

[132] The t-statistic for the autocorrelation coefficient is measured as follows:

$t = r_{x,y} \sqrt{N-2} \; / \; \sqrt{1-r_{x,y}^2}$ where $r_{x,y}$ is the correlation coefficient, $x$ is the discount at time $t$ and $y$ is the discount at time $t$-$j$, where $j = 1$ to 12. $N$ is the number of observations.

Table 6.4. Autocorrelation of the categories' discount

The table shows the average first- to twelfth-order autocorrelation of discount levels (Panel A) and discount first-differences (Panel B). The t-statistics of the autocorrelation coefficients are shown in brackets. The results are the average for all fourteen categories. We use monthly data from January 1980 to March 1997.

Panel A: Autocorrelation in Levels

| | 1 month | 2 months | 3 months | 4 months | 5 months | 6 months | 7 months | 8 months | 9 months | 10 months | 11 months | 12 months |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 0.93<br>(36.50) | 0.89<br>(27.57) | 0.85<br>(23.02) | 0.82<br>(20.61) | 0.80<br>(19.05) | 0.77<br>(17.41) | 0.75<br>(16.14) | 0.72<br>(15.03) | 0.70<br>(14.03) | 0.68<br>(13.13) | 0.65<br>(12.19) | 0.64<br>(11.78) |

Panel B: Autocorrelation in First Differences

| | 1 month | 2 months | 3 months | 4 months | 5 months | 6 months | 7 months | 8 months | 9 months | 10 months | 11 months | 12 months |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | -0.18<br>(-2.68) | -0.04<br>(-0.53) | -0.09<br>(-1.23) | -0.03<br>(-0.39) | 0.04<br>(0.64) | -0.02<br>(-0.25) | 0.02<br>(0.31) | -0.01<br>(-0.17) | -0.03<br>(-0.39) | 0.03<br>(0.44) | -0.08<br>(-1.12) | -0.01<br>(-0.20) |

Table 6.4 describes the average autocorrelation of the fourteen categories' discount. Table 6.5 details the results for the International General category. Panels A and B show the autocorrelation of the category's discount in terms of levels and first differences, respectively. As a comparison, we show the average autocorrelation in levels and first differences, respectively, of the individual funds in the category. The results show that average autocorrelation of the individual funds' discount levels is slightly lower than the corresponding values for the category's discount. This tends to indicate that the average discount of the category is less volatile than the individual funds. In contrast, the comparison of the first order autocorrelation in the discount first differences shows a higher negative correlation when we average the results from the 18 individual funds than when we consider the average discount of the category. The results might suggest that the evidence of price reversal is weaker when we consider the discount as an average for the category.

Table 6.5: Autocorrelation of the International General category discount

The table shows the first- to twelfth-order autocorrelation of discount levels (Panel A) and discount first-differences (Panel B) for the International General category. The t-statistics of the autocorrelation coefficients are shown in brackets. The rows labelled 'Category discount' show the results for the discount of the International General category. The rows labelled 'Average individual funds' represent the average autocorrelation from the 18 individual funds in the International General category. We use monthly data from January 1980 to March 1997.

Panel A: Autocorrelation in Levels

| | 1 month | 2 months | 3 months | 4 months | 5 months | 6 months | 7 months | 8 months | 9 months | 10 months | 11 months | 12 months |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category discount | 0.97<br>(60.94) | 0.96<br>(47.11) | 0.94<br>(39.31) | 0.93<br>(35.78) | 0.92<br>(34.37) | 0.91<br>(32.24) | 0.91<br>(30.58) | 0.89<br>(28.39) | 0.88<br>(27.15) | 0.88<br>(26.81) | 0.89<br>(27.17) | 0.88<br>(26.98) |
| Average individual funds | 0.90<br>(30.33) | 0.86<br>(23.78) | 0.82<br>(20.12) | 0.79<br>(18.12) | 0.77<br>(17.32) | 0.75<br>(16.23) | 0.76<br>(16.65) | 0.75<br>(16.05) | 0.76<br>(16.87) | 0.76<br>(16.87) | 0.73<br>(15.30) | 0.75<br>(16.12) |

Panel B: Autocorrelation in First Differences

| | 1 month | 2 months | 3 months | 4 months | 5 months | 6 months | 7 months | 8 months | 9 months | 10 months | 11 months | 12 months |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category discount | -0.18<br>-(2.61) | 0.01<br>(0.11) | -0.12<br>-(1.79) | -0.10<br>-(1.50) | 0.06<br>(0.91) | 0.01<br>(0.10) | 0.10<br>(1.40) | -0.06<br>-(0.88) | -0.13<br>-(1.80) | -0.06<br>-(0.82) | 0.03<br>(0.45) | 0.06<br>(0.87) |
| Average individual funds | -0.27<br>-(3.94) | -0.04<br>-(0.59) | -0.07<br>-(0.98) | -0.05<br>-(0.65) | 0.03<br>(0.42) | -0.04<br>-(0.60) | 0.08<br>(1.08) | -0.06<br>-(0.84) | 0.02<br>(0.31) | -0.02<br>-(0.27) | -0.05<br>-(0.71) | 0.07<br>(0.93) |

## 5. Stationarity

A series is said to be stationary if it tends to revert to its mean and fluctuate around it within a certain range. The literature tends to suggest that discounts are stationary. Pontiff (1995) argues that discounts can reasonably be expected to remain stationary over long periods but not necessarily over short intervals[133]. The results are similar to those reported by Ammer (1990) who concludes that the aggregate discount of British closed-end funds is stationary.

However, if the discounts follow a mean-reverting process or if there is a trend to their mean, then the assumption of stationarity is no longer valid. Several papers suggest that discounts have a tendency to return towards the levels predicted by fundamentals - discounts are mean-reverting. Thompson (1978) and Pontiff (1995) argue that trading strategies based on the level of discount accrue abnormal returns. The results are less compelling for the UK market but Cheng, Copeland and O'Hanlon (1994) interpret the evidence as an apparent rejection of the semi-strong form of market efficiency.

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[133] Pontiff (1995) conducts an augmented Dickey-Fuller test on 49 funds with more than 25 months of data. For 53 per cent of the funds the test rejects a unit root at the 10 per cent significance level.

In this section we investigate the processes generating the discount. We test whether discounts on UK closed-end funds follow a random walk or are a stationary process. The analysis of the speed of adjustment gives insights to the mean-reverting pattern. The results show that for more than 60 percent of the funds, the discount follows a mean-reverting process. The average speed of adjustment for the fourteen categories is 0.17.

## 5.1. The unit root test

The problem of testing the hypothesis that $\beta=1$ in the first order autoregressive equation of the form $X_t = \mu + \beta X_{t-1} + \varepsilon_t$ is called testing for "unit roots". The characterisation of the discount behaviour as being a random walk process - existence of a unit root - implies that regular shocks have a permanent effect on the level of the time series. The hypothesis and the specifications of the test are the following:

$$d_{t,j} \quad \mu + \beta d_{t-1,j} + \varepsilon_{t,j} \tag{6.2}$$

where $d_{t,j}$ is the level of the discount at time $t$ on fund $j$.

$H_0$ : $\beta = 1$ the discount follows a random walk (existence of a unit root)

$H_1$ : $\beta | < 1$ the discount is stationary[134]

The existence of a unit root is measured using an augmented Dickey-Fuller test. Dickey and Fuller (1979, 1981) show that the conventional least square estimate of $\beta$ is not distributed around one under the hypothesis of a random walk (the true value of

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[134] For each of the 244 funds in our sample, the estimated values of the $\beta$ lie in the positive interval [0,1]. We, therefore, restrict the analysis to test whether $0 \leq \beta \leq 1$.

$\beta$ is one), but rather around a value less than one. The introduction of the lagged first difference terms accommodate for higher-order autoregressive moving average processes in $\varepsilon_t$. A convenient reformulation of the model allows the testing of the hypothesis that $\beta^*$ equals zero[135].

$$\Delta d_{t,j} = d_{t,j} - d_{t-1,j} = \mu + \beta^* d_{t-1,j} + \Sigma \phi_i \Delta d_{t-1,j} + \varepsilon_{t,j} \tag{6.3}$$

To carry on the test, they derive an appropriate set of critical values. For a level of significance of 5 percent and a sample size larger than 100 observations, the critical value of the t-statistic from Dickey-Fuller's tables is -3.12.

For a model with a time trend, represented in Equation (6.4) by the *term* $\gamma t$, the unit root null hypothesis implies that both $\gamma$ and $\beta^*$ are equal to zero.

$$\Delta d_{t,j} - d_{t,j} - d_{t-1,j} = \mu + \gamma t + \beta^* d_{t-1,j} + \sum_{i=1}^{p-1} \phi_i \Delta d_{t-i,j} + \varepsilon_{t,j} \tag{6.4}$$

where $\phi_i = - \sum_{k-i+1}^{p} \beta_K$ and $\beta^* = \sum_{h=1}^{p} \beta_h - 1$

For a level of significance of 5 percent and a sample size larger than 100 observations, the critical value of the F-ratio from Dickey-Fuller is 6.25 while the corresponding F value from the standard F-tables is 3.00[136].

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[135] To define the appropriate number of lagged first difference terms in the augmented Dickey-Fuller model, we increase the lag terms until the residuals from the regression, $\varepsilon_t$, are white noise. We consider the value of the Durbin-Watson, but the choice of the correct model is based on the values from an Autoregressive Integrated Moving Average (ARIMA) procedure.

[136] The F-ratio is calculated as follows: $F = \left[(R_{uc} - R_c)/q\right] / \left[(1 - R_{uc})/(n-k)\right]$

where, $R_{uc}$ = unconditioned R-squared, determined from the complete regression
$R_c$ = conditioned R-squared, determined from the regression where the two coefficients, $\beta$ and $\gamma$, are constrained to be equal to zero
$q$ = set of constraints = 2
$k$ = number of regressors, including the intercept.

## 5.2. Mean-reverting process

The distinction between a random walk and a stationary series is dependent upon the value of $\beta$. If the coefficient is not significantly different from 1, the series is said to follow a random walk. However, the definition of stationarity is based on stronger assumptions. A stochastic process is said to be weakly stationary if neither the mean, nor the autocovariances depend on the date $t$ (the series has a constant mean and variance - one of the implications is that $\beta$ is equal to 0). If the value of $\beta$ is lower than 1, it is important to consider whether the value of the coefficient is close to 0 or lies somewhere between 0 and 1. If $0 < \beta < 1$ the process is mean-reverting.

We assume that the discounts follow a mean-reverting process of the general form:

$$\textit{Model 1:} \quad \Delta d_t = \theta (\kappa^* - d_{t-1}) \Delta t + \sigma \Delta z \tag{6.5}$$

where $d_{t-1}$ is the discount level at time $t-1$, $\theta$ is the speed of adjustment (measure of the degree of mean-reversion to the long run mean discount), $\kappa^*$ is the long run equilibrium discount, $\sigma$ is the volatility of the stochastic process and $\Delta z$ is the increment to a standard Brownian motion[137]. If $0 < \theta < 1$, the process is mean-reverting. If $\theta$ is equal to 1 and the long run equilibrium discount is constant, the process is stationary. The test of mean-reversion considers the following trend to the mean.

$$\textit{Model 2:} \quad \Delta d_t = \theta (\kappa^{**} + \phi t - d_{t-1}) \Delta t + \sigma \Delta z \tag{6.6}$$

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[137] A standard Brownian motion or Gauss-Wiener process $\{ z_t, t \in [0, \infty)\}$ is a stochastic process in which the increment $dz$ is distributed as $\varepsilon\sqrt{dt}$, where $\varepsilon$ is the standard normal random variable (with mean 0 and variance 1). The increment to the standard Brownian motion is normally distributed with mean 0 and variance $dt$.

where $\kappa^{**}$ *is* the long run equilibrium discount at time zero and $\phi$ is the drift of the stochastic process.

Using monthly values of the average discount of the categories, as defined by the AITC classification, we estimate the regressions based on Model 1 and Model 2 for which $\Delta t = 1$:

*Regression 1:* $$d_t = \beta_0 + \beta_1 d_{t-1} + \varepsilon_t \qquad (6.7)$$

Using Model 1 and Regression 1, and equating coefficients, we can demonstrate that $\theta = 1 - \beta_1$ and $\kappa^* = \beta_0/(1-\beta_1)$.

*Regression 2:* $$\mathrm{d}_t = \beta_0 + \beta_1 \mathrm{d}_{t-1} + \beta_2 \mathrm{t} + \varepsilon_t \qquad (6.8)$$

Using Model 2 and Regression 2, and equating coefficients, we can demonstrate that $\theta = 1 - \beta_1$, $\kappa^{**} = \beta_0/(1-\beta_1)$ and $\phi = \beta_2\ (1-\beta_1)$.[138]

If the discounts follow a mean-reverting process, then the $\beta_1$ coefficient estimated in the two regressions should be significantly greater than zero and less than one. The existence of a trend to the mean would imply the $\beta_2$ coefficient estimated in Regression 2 to be significantly different from zero. Alternatively, if the process generating the discount is stationary, $\beta_1$ ought to be close to zero and $\kappa^*$ to be constant.

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[138] Estimating Regression 2 based on Model 2, for which $\Delta t = 1$, we can demonstrate that equating the coefficients :

*Model 2:*
$$\Delta d_t = \theta(\kappa^{**} + \phi t - d_{t-1})\,\Delta t + \sigma \Delta z$$
$$d_t - d_{t-1} = \theta(\kappa^{**} + \phi t - d_{t-1}) + \varepsilon_t$$
$$d_t = \theta\kappa^{**} + \theta\phi t + (1-\theta) d_{t-1} + \varepsilon_t$$

*Regression 2:* $$\mathrm{d}_t = \beta_0 + \beta_1 \mathrm{d}_{t-1} + \beta_2 \mathrm{t} + \varepsilon_t$$

$1 - \theta = \beta_1 \rightarrow \theta = 1 - \beta_1$

$\theta\kappa^{**} = \beta_0 \rightarrow \kappa^{**} = \beta_0/(1-\beta_1)$

$\theta\phi = \beta_2 \rightarrow \phi = \beta_2/(1-\beta_1)$

## 5.3. Mean-reversion in the behaviour of small/large-discount portfolios.

The performance of small and large-discount portfolios is a first indication of the importance of mean-reversion in the discounts. We rank the 244 funds according to the level of their discount and construct two portfolios, defined as small and large-discount portfolios, containing the top and bottom decile, respectively. The portfolios' discount, defined as the logarithm of the equally-weighted average of the price to NAV ratios, is then measured over a one-year period. The ranking is repeated every six months, at the beginning of January and July. Portfolios are constructed one month after the ranking. Of the 244 funds in our sample, 172 were launched after January 1980. The results from the ranking are therefore affected by the premiums at which the funds are issued.

Figure 6.1 shows the tendency for discounts to revert to their mean - the discount of the small-discount portfolio tends to increase whereas the discount of the large-discount portfolio tends to decrease. The plot representing the arbitrage portfolio, long in the large-discount decile and short in the small-discount decile, shows a significant decrease in the absolute value of the difference between the long and the short position. On average the arbitrage portfolio moves from a discount of 66 percent to 42 percent[139]. The result tends to suggest that discounts are mean-reverting and that there is the potential for generating positive returns. However, risk adjustments and transaction costs would potentially reduce the gain considerably.

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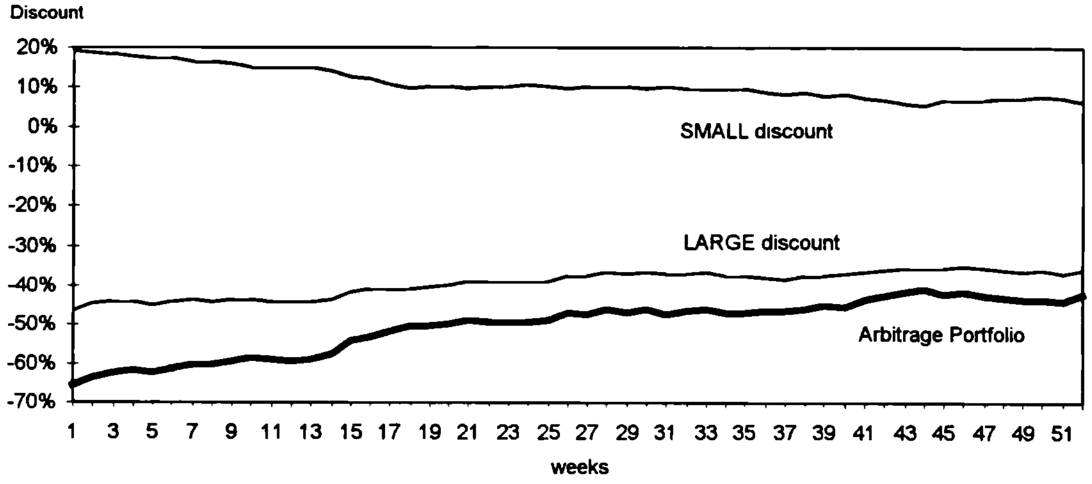
[139] The average result from all the rankings show that the discount of the bottom decile increases by 11 percentage points and the corresponding value for the top decile decreases by 13 percentage points. However, the decrease of the small discount portfolio partly reflects the fact that new funds are launched at a premium of up to 10 per cent to NAV, which moves to a discount within a short period.

Figure 6.1. Average mean-reversion of the top and bottom decile portfolio

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 sample of 244 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 weekly data from January 1980 to March 1997.



## 5. 4. Results

Using the models described in Regression 1 and 2, we attempt to characterise the behaviour of UK closed-end fund discounts. We test whether the process is stationary, follows a random walk or is mean-reverting. The results are based on the average discount of the categories defined by the AITC classification. For each category we define the discount as the logarithm of the average price to NAV ratios.

Table 6.6 shows the results of Regression 1, defined in Equation (6.7), where we regress the levels of the category discount on the lag terms. We find an average adjusted R-squared of 86.9 percent and a long-run equilibrium monthly discount of 14.1 percent. The speed of adjustment coefficient, $\theta$, is very close to zero (0.08). This suggests that the process is non stationary and that the mean-reversion speed is very low. The average coefficient of the lag term, 0.92, is highly significant and close to one. In order to determine whether the value is significantly lower than 1 - and thus, reject the unit root hypothesis - we refer to the Dickey-Fuller test described in

Equation (6.3). The results show that for most categories we cannot reject the null hypothesis of a unit root - the lag coefficient β is not significantly greater than zero. The t-statistics are lower than the critical value of -3.12. The average t-statistic for all categories is -2.47. The results of a regression model without a time trend tend to suggest that the category discount follows a random walk.

Table 6.6. Regression 1 Results

The table shows the results from Regression 1, described in Equation (6.7) for the discount of 14 categories of UK closed-end funds. The t-statistic of the coefficients are shown in brackets. The augmented Dickey-Fuller test, as defined by Equation (6.3) is used to determine if the lag coefficient $\beta^*$ is greater than zero. The critical value for the t-statistic is -3.12. We use monthly data from January 1980 to March 1997.

| | Regression 1 | | | | | | Unit Root Test | |
|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept $\beta_0$ | Lag $\beta_1$ | Speed of adjustment $\theta = 1-\beta_1$ | Long run equilibrium $\kappa^* = \beta_0/(1-\beta_1)$ | Lag $\beta^*$ | t-statistic |
| International General | 94.8 | 206 | -0.01<br>(-1.62) | 0.97<br>(60.94) | 0.03 | -0.167 | -0.0338 | -2.13 |
| International Capital Growth | 90.1 | 206 | -0.01<br>(-2.64) | 0.93<br>(43.20) | 0.07 | -0.195 | -0.0654 | -3.02 |
| International Income Growth | 94.0 | 206 | -0.01<br>(-1.57) | 0.96<br>(56.59) | 0.04 | -0.164 | -0.0239 | -1.48 |
| UK General | 94.3 | 206 | -0.01<br>(-1.64) | 0.96<br>(58.32) | 0.04 | -0.154 | -0.0359 | -2.17 |
| UK Capital Growth | 87.5 | 206 | -0.01<br>(-2.15) | 0.93<br>(37.85) | 0.07 | -0.156 | -0.0399 | -1.67 |
| UK Income Growth | 96.2 | 206 | 0.00<br>(-1.17) | 0.97<br>(72.24) | 0.03 | -0.100 | -0.0223 | -1.72 |
| High Income | 81.7 | 206 | 0.00<br>(-0.90) | 0.90<br>(30.31) | 0.10 | -0.024 | -0.0982 | -3.30 |
| Closed-End Fund | 92.0 | 206 | -0.01<br>(-1.49) | 0.96<br>(48.49) | 0.04 | -0.147 | -0.0448 | -2.27 |
| Smaller Companies | 92.8 | 206 | -0.01<br>(-2.04) | 0.96<br>(51.29) | 0.04 | -0.166 | -0.0361 | -1.89 |
| North America | 77.7 | 206 | -0.03<br>(-3.66) | 0.87<br>(26.73) | 0.13 | -0.198 | -0.1303 | -4.01 |
| Far East including Japan | 87.6 | 206 | -0.01<br>(-2.48) | 0.93<br>(38.04) | 0.07 | -0.172 | -0.0585 | -2.28 |
| Far East excluding Japan | 65.7 | 139 | -0.03<br>(-3.89) | 0.79<br>(16.29) | 0.21 | -0.117 | -0.1852 | -3.18 |
| Japan | 76.8 | 206 | -0.02<br>(-3.08) | 0.88<br>(26.10) | 0.12 | -0.139 | -0.0791 | -2.20 |
| Continental Europe | 85.0 | 206 | -0.01<br>(-2.78) | 0.91<br>(34.05) | 0.09 | -0.148 | -0.0881 | -3.29 |
| **Average** | **86.9** | **201** | **-0.01**<br>**(-2.22)** | **0.92**<br>**(42.89)** | **0.08** | **-0.141** | **-0.0673** | **-2.47** |

However, the behaviour of the discount, as illustrated in Figure 2.1, would suggest the existence of a time trend. Table 6.7 shows the results of Regression 2, defined in Equation (6.8), where we regress the discount on the lag coefficient and a trend. The average t-statistic of the trend coefficient, 2.88, is significant at the 1 percent level. The average adjusted R-squared, 87.3 percent, is higher than the result for Regression 1. The results tend to suggest that the introduction of a time trend is a better representation of the behaviour of the discount.

Table 6.7 shows that $\beta_1$, the average lag coefficient, is lower than the result based on Regression 1. This suggests that we are moving away from the value of 1, which corresponds to a random walk. However, we need the Dickey-Fuller test described in Equation (6.4) to decide whether we can reject the unit root hypothesis. The results show that the joint hypothesis of $\gamma$ and $\beta^*$ being equal to zero is rejected for seven categories - International General, International Capital Growth, UK Capital Growth Smaller Companies, North America, Far East including Japan and Far East excluding Japan. The results show that for 50 percent of the categories under investigation[140] (representing 60 percent of the sample funds), we reject the unit root hypothesis in favor of stationarity. However, as discussed previously, the definition of stationarity is based on stronger assumptions. If $0 < \beta_1 < 1$ the process is mean-reverting. Regression 2 is characterised by an average lag coefficient of 0.83. The regression model with a time trend tends to suggest that for the majority of funds, more than 60 percent, the discount is a mean-reverting process. The average speed of adjustment for the fourteen categories is 0.17. The long-run equilibrium monthly discount at time zero, 1980, is 26.0 percent.

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[140] The augmented Dickey-Fuller test on the discount of individual funds results in rejecting the unit root hypothesis for approximately 65 per cent of the funds.

The analysis shows that UK closed-end funds have a tendency to return to their mean and fluctuate around it within a certain range. The results are consistent with the evidence reported in Figure 6.1.

Table 6.7 : Regression 2 Results

The table shows the results from Regression 2, described in Equation (6.8) for the discount of 14 categories of UK closed-end funds. The t-statistic of the coefficients is shown in brackets. The augmented Dickey-Fuller test, as defined by Equation (6.4) is used to determine if the lag coefficient $\beta^*$ is greater than zero. The critical value for the F-ratio is 6.25. We use monthly data from January 1980 to March 1997.

| | Regression 2 | | | | | | | | Unit Root Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept $\beta_0$ | Lag $\beta_1$ | Trend $\beta_2$ | Speed of adjustment $\theta = 1-\beta_1$ | Rate of drift $\phi = \beta_2/(1-\beta_1)$ | Long run equilibrium $\kappa^{**} = \beta_0\ (1-\beta_1)$ | Trend $\gamma$ | Lag $\beta^*$ | F-ratio |
| International General | 95.1 | 206 | -0.06<br>(-4.30) | 0.81<br>(18.86) | 0.00025<br>(4.02) | 0.19 | 0.00130 | -0.3303 | 0.00022 | -0.1696 | 7.146 |
| International Capital Growth | 91.0 | 206 | -0.08<br>(-5.28) | 0.75<br>(16.61) | 0.00023<br>(4.63) | 0.25 | 0.00092 | -0.3043 | 0.00022 | -0.2413 | 12.396 |
| International Income Growth | 94.2 | 206 | -0.04<br>(-3.20) | 0.88<br>(24.93) | 0.00018<br>(2.87) | 0.12 | 0.00141 | -0.3326 | 0.00011 | -0.0788 | 2.722 |
| UK General | 94.6 | 206 | -0.05<br>(-3.74) | 0.85<br>(22.64) | 0.00018<br>(3.42) | 0.15 | 0.00118 | -0.3018 | 0.00016 | -0.1351 | 6.113 |
| UK Capital Growth | 88.8 | 206 | -0.10<br>(-5.47) | 0.71<br>(14.21) | 0.00044<br>(5.04) | 0.29 | 0.00151 | -0.3274 | 0.00033 | -0.2201 | 8.731 |
| UK Income Growth | 96.4 | 206 | -0.04<br>(-3.36) | 0.86<br>(22.30) | 0.00022<br>(3.20) | 0.14 | 0.00150 | -0.2934 | 0.00014 | -0.0952 | 3.405 |
| High Income | 81.7 | 206 | -0.01<br>(-1.14) | 0.89<br>(27.64) | 0.00004<br>(0.81) | 0.11 | 0.00033 | -0.0584 | 0.00003 | -0.1054 | 5.201 |
| Closed-End Fund | 92.0 | 206 | -0.02<br>(-2.06) | 0.94<br>(43.70) | 0.00011<br>(1.53) | 0.06 | 0.00184 | -0.3298 | 0.00004 | -0.0394 | 1.878 |
| Smaller Companies | 93.0 | 206 | -0.03<br>(-3.14) | 0.89<br>(26.61) | 0.00009<br>(2.55) | 0.11 | 0.00077 | -0.2557 | 0.00022 | -0.2740 | 13.125 |
| North America | 79.5 | 206 | -0.09<br>(-5.63) | 0.70<br>(14.28) | 0.00024<br>(4.38) | 0.30 | 0.00081 | -0.2865 | 0.00022 | -0.2740 | 13.125 |
| Far East including Japan | 88.5 | 206 | -0.07<br>(-4.77) | 0.77<br>(17.29) | 0.00028<br>(4.15) | 0.23 | 0.00122 | -0.3121 | 0.00028 | -0.2316 | 11.907 |
| Far East excluding Japan | 65.6 | 139 | -0.03<br>(-3.25) | 0.79<br>(16.25) | 0.00007<br>(0.72) | 0.21 | 0.00031 | -0.1392 | 0.00004 | -0.1928 | 6.279 |
| Japan | 76.8 | 206 | -0.02<br>(-2.68) | 0.87<br>(25.02) | 0.00004<br>(0.86) | 0.13 | 0.00032 | -0.1725 | 0.00003 | -0.0933 | 3.250 |
| Continental Europe | 85.2 | 206 | -0.03<br>(-3.21) | 0.87<br>(25.19) | 0.00009<br>(2.07) | 0.13 | 0.00065 | -0.2192 | 0.00007 | -0.1120 | 5.095 |
| **Average** | 87.3 | **201** | -0.05<br>(-3.66) | **0.83**<br>**(22.54)** | 0.00017<br>**(2.88)** | **0.17** | **0.00100** | **-0.2696** | **0.00015** | **-0.1616** | **7.169** |

## 6. Cointegration

Discounts are characterized by large fluctuations over time and across funds. The remaining question is to investigate whether discounts tend to move together. The correlogram of the changes in the discount is a first indication of the co-movement level. Based on the funds in the International General category, we find an average correlation of 0.30 between the changes in the discount of all pairs of funds[141]. The result suggests that changes in the discount of a fund are correlated with the changes in the other funds' discounts. Table 6.8 shows the results of the correlation between changes in the discount of the different categories. The correlogram shows high correlation.

Table 6.8 : Correlogram of Category Discounts' First Differences

The table shows the correlogram of the category discounts' first differences. We define the discount of the category as the logarithm of the equally-weighted average price to NAV ratios. For all pairs of AITC categories we compute the correlation between the discount changes. We use monthly data from January 1980 to March 1997.

| | INCG | INIG | UKGN | UKCG | UKIG | HIGH | CLOS | SMCO | NTHA | FEJP | FARE | JAPN | EURO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INGN | 0.80 | 0.73 | 0.27 | 0.10 | 0.68 | 0.17 | -0.01 | 0.54 | 0.59 | 0.55 | 0.27 | 0.44 | 0.49 |
| INCG | | 0.60 | 0.27 | 0.18 | 0.56 | 0.07 | 0.06 | 0.51 | 0.47 | 0.50 | 0.27 | 0.44 | 0.52 |
| INIG | | | 0.12 | 0.01 | 0.57 | 0.09 | 0.00 | 0.41 | 0.52 | 0.43 | 0.11 | 0.33 | 0.38 |
| UKGN | | | | 0.20 | 0.35 | 0.13 | 0.11 | 0.34 | 0.14 | -0.01 | 0.05 | -0.10 | 0.07 |
| UKCG | | | | | 0.20 | 0.12 | 0.08 | 0.20 | 0.00 | 0.01 | -0.09 | -0.08 | -0.06 |
| UKIG | | | | | | 0.25 | -0.01 | 0.55 | 0.36 | 0.28 | 0.05 | 0.22 | 0.24 |
| HIGH | | | | | | | 0.03 | 0.11 | 0.12 | 0.04 | 0.02 | 0.00 | -0.07 |
| CLOS | | | | | | | | 0.02 | 0.13 | 0.03 | 0.24 | 0.05 | 0.05 |
| SMCO | | | | | | | | | 0.35 | 0.26 | 0.05 | 0.20 | 0.31 |
| NTHA | | | | | | | | | | 0.50 | 0.35 | 0.42 | 0.33 |
| FEJP | | | | | | | | | | | 0.33 | 0.57 | 0.39 |
| FARE | | | | | | | | | | | | 0.35 | 0.39 |
| JAPN | | | | | | | | | | | | | 0.44 |

A more robust specification of the co-movement in the discount changes of different funds is provided by a cointegration test. The theory of cointegration developed by Engle and Granger (1987) addresses the issue of integrating short-run dynamics with long-run equilibria. If two variables are said to be cointegrated, it implies that there is a long-run relationship between their trends and, therefore, they do not drift too far apart from each other over time. Engle and Granger suggest estimating, by ordinary least squares, the following regression equation:

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[141] For the funds in the International General category we compute the correlogram of discount first differences - for all pairs of funds in the category we calculate the correlation between the discount changes. 0.30 is the equally-weighted average of all correlation coefficients.

$$d_{t,j} - \varphi d_{t,i} + u_t \qquad (6.9)$$

where $d_{t,j}$ and $d_{t,i}$ correspond to the level of discount of fund $j$ and $i$, respectively. The augmented Dickey-Fuller test described in Equation (6.2) is then applied to the estimated residuals, $\hat{u}_t$.

$$\hat{u}_t = \mu + \beta u_{t-1} + \varepsilon_t \qquad (6.10)$$

$H_0$ : $\beta = 1$ No cointegration (existence of a unit root)
$H_1$ : $|\beta| < 1$ Cointegration of the discounts

A convenient reformulation of the model allows us to test the hypothesis that $\beta^*$ equals zero

$$\Delta u_t = u_t - u_{t-1} = \mu + \beta^* u_{t-1} + \sum_{i=1}^{p-1} \phi_i \Delta u_{t-1} + \varepsilon_t \qquad (6.11)$$

where $\phi_i = -\sum_{k=i+1}^{p} \beta_K$ and $\beta^* = \sum_{h=1}^{p} \beta_h - 1$

Based on Dickey-Fuller's tables, the critical value of the t-statistic for the lag coefficient is -3.12 (level of significance of 5 percent and a sample size larger than 100 observations). If the null hypothesis of a unit root is rejected, the discounts are taken to be cointegrated.

Table 6.9 shows the result of the cointegration test based on the funds in the International General category. For each fund in the category, we measure the cointegration between the fund and the average discount of the category, where we exclude from the average the fund of interest. In Equation (6.9), $j$ corresponds to the fund discount and $i$ to the category discount. As expected from a correct specification of the augmented Dickey-Fuller model, the residuals in Equation (6.11) are white noise. The average Durbin-Watson value is very close to 2. The t-statistic for the lag coefficient $\beta^*$ is, on average, larger than the critical value of -3.12, suggesting that the coefficient is significantly different from zero. For 70 percent of the funds we reject the null hypothesis of a unit root. The results show that the discounts of funds in the same category tend to be cointegrated. Similar results are obtained for other categories but for reasons of space they are not reported here.

Table 6.9 : Cointegration between the Fund and the Category Discount - International General category

The table shows the result of the cointegration test based on the funds in the International General category. For each fund in the category, we measure the cointegration between the fund, $d_{t,j}$, and the average discount of the category, $d_{t,i}$, where we exclude the fund of interest. We use the augmented Dickey-Fuller test on the residuals from Equation (6.9). Equation (6.11) describes the model. The table reports the estimated value of the lag coefficient, $\beta^*$, and the t-statistic. If we reject the null hypothesis of a unit root, the discount are taken to be cointegrated. The critical value for the t-statistic is -3.12. We use monthly data from January 1980 to March 1997.

| | Obs | Durbin-Watson | Lag coefficient $\beta^*$ | t-statistic |
|---|---|---|---|---|
| The Alliance Trust PLC | 207 | 2.00 | -0.175 | -3.00 |
| The Bankers Investment Trust PLC | 207 | 2.08 | -0.351 | -5.31 |
| Baring Tribune Investment Trust PLC | 207 | 2.03 | -0.198 | -3.57 |
| British Investment Trust | 207 | 2.01 | -0.267 | -4.31 |
| The Brunner Investment Trust PLC | 207 | 2.03 | -0.245 | -4.65 |
| Foreign & Colonial Investment Trust PLC | 207 | 2.01 | -0.226 | -4.20 |
| The Law Debenture Corporation PLC | 207 | 2.04 | -0.173 | -3.74 |
| Majedie Investment PLC | 138 | 2.04 | -0.359 | -5.45 |
| Mid Wynd International Investment Trust PLC | 189 | 1.89 | -0.186 | -4.44 |
| Personal Assets Trust PLC | 164 | 2.04 | -0.100 | -2.61 |
| Premium Trust | 19 | 1.96 | -0.576 | -2.56 |
| The Scottish American Investment Company PLC | 207 | 2.03 | -0.100 | -2.16 |
| The Scottish Eastern Investment Trust PLC | 207 | 2.06 | -0.121 | -2.67 |
| The Scottish Mortgage and Trust PLC | 207 | 2.00 | -0.403 | -5.65 |
| Scottish Investment Trust PLC | 207 | 2.01 | -0.158 | -3.61 |
| The Second Alliance Trust PLC | 207 | 1.98 | -0.180 | -3.30 |
| Witan Investment Company PLC | 207 | 2.24 | -0.264 | -5.57 |
| **Average** | **188** | **2.03** | **-0.24** | **-3.93** |

The evidence that the discounts of funds in the same category tend to move together leads to the question of whether the average discounts of the different categories are cointegrated. We define the category discount as the logarithm of the average price to NAV ratios. For each pair of combinations, we apply the augmented Dickey-Fuller test. In Equation (6.9), $j$ and $i$ correspond to the discount of category $j$ and $i$, respectively. In Table 6.10 we report the t-statistic for the lag coefficient $\beta^*$. A value larger than the critical -3.12 suggests that the discounts of the two categories are cointegrated.

Table 6.10 : Cointegration between the Discounts of the Different Categories

The table shows the result of the cointegration between the discounts of the different categories. We define the category discount as the logarithm of the average price to NAV ratios. For each pair of combinations, we apply the augmented Dickey-Fuller test on the residuals from Equation (6.9). Equation (6.11) describes the model. The table reports the t-statistic for the estimated lag coefficient $\beta^*$. If we reject the null hypothesis of a unit root, the discount are taken to be cointegrated. The critical value for the t-statistic is -3.12. We use monthly data from January 1980 to March 1997. The categories are described by their abbreviated mnemonics: International General (INGN), International Capital Growth (INCG), International Income Growth (INIG), UK General (UKGN), UK Capital Growth (UKCG), UK Income Growth (UKIG), High Income (HIGH), Closed-End Funds (CLOS), Smaller Companies (SMCO), North America (NTHA), Far East including Japan (FEJP), Far East excluding Japan (FARE), Japan (JAPN) and Continental Europe (EURO).

| | INCG | INIG | UKGN | UKCG | UKIG | HIGH | CLOS | SMCO | NTHA | FEJP | FARE | JAPN | EURO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INGN | $\boxed{-3.33}$ | $\boxed{-3.25}$ | $\boxed{-5.32}$ | $\boxed{-5.68}$ | $\boxed{-3.96}$ | -2.33 | -2.65 | -2.23 | $\boxed{-4.22}$ | $\boxed{-3.46}$ | -1.91 | -2.04 | -2.35 |
| INCG | | $\boxed{-3.94}$ | $\boxed{-5.26}$ | $\boxed{-5.21}$ | $\boxed{-4.67}$ | -3.09 | $\boxed{-3.75}$ | -2.71 | $\boxed{-4.92}$ | $\boxed{-3.90}$ | -2.92 | -2.84 | -3.09 |
| INIG | | | $\boxed{-3.18}$ | $\boxed{-4.55}$ | $\boxed{-3.36}$ | -1.73 | -1.87 | -3.07 | $\boxed{-4.29}$ | -2.84 | -1.81 | -1.45 | -2.86 |
| UKGN | | | | $\boxed{-6.30}$ | $\boxed{-5.03}$ | -2.27 | -2.67 | $\boxed{-4.30}$ | $\boxed{-5.17}$ | $\boxed{-3.63}$ | -2.48 | -1.97 | -2.16 |
| UKCG | | | | | $\boxed{-5.81}$ | -1.60 | -2.16 | $\boxed{-4.81}$ | $\boxed{-6.39}$ | -2.39 | -1.43 | -1.80 | -1.92 |
| UKIG | | | | | | -1.81 | -1.89 | $\boxed{-3.90}$ | $\boxed{-4.72}$ | $\boxed{-3.54}$ | -1.91 | -1.74 | -2.10 |
| HIGH | | | | | | | $\boxed{-3.31}$ | $\boxed{-3.57}$ | $\boxed{-3.51}$ | $\boxed{-3.83}$ | -1.92 | -2.52 | $\boxed{-3.45}$ |
| CLOS | | | | | | | | -2.56 | -2.86 | -2.74 | $\boxed{-3.19}$ | -2.59 | $\boxed{-4.03}$ |
| SMCO | | | | | | | | | $\boxed{-5.72}$ | -2.58 | -1.50 | -1.98 | -2.20 |
| NTHA | | | | | | | | | | $\boxed{-5.07}$ | $\boxed{-3.72}$ | $\boxed{-3.87}$ | $\boxed{-4.61}$ |
| FEJP | | | | | | | | | | | -2.82 | -2.05 | -1.77 |
| FARE | | | | | | | | | | | | $\boxed{-3.15}$ | $\boxed{-3.64}$ |
| JAPN | | | | | | | | | | | | | -2.12 |

The results show that there is strong evidence of cointegration within the International (International General, International Capital Growth and International Income Growth) and UK (UK General, UK Capital Growth and UK Income Growth) categories. The t-statistics are all larger than the critical value, in particular within the UK categories. On average, the International and UK categories show evidence of cointegration with more than half of the total number of categories. An interesting result is the cointegration pattern of the North America category. The average discount seems to move together with almost all the other categories. The Closed-End Fund, Far East excluding Japan and Continental Europe categories show little evidence of cointegration, but the one category that seems to stand alone is the Japan category. The discount seems to move only with the North America and Far East excluding

Japan categories. The overall results show strong evidence of the UK closed-end fund discounts moving together.

## 7. Seasonality in the discount

This last section investigates the behaviour of the discount over periods of months. In particular we are concerned with whether the changes in the discount during the month of January are significantly different from the rest of the year. Table 6.11 shows the percentage average discount changes over each month. The results show that, on average, the discount decreases (the logarithm of the price to NAV ratio increases) during the month of January. However, the average first differences are not significantly different from the rest of the year. The results tend to suggest that the behaviour of the discount is not characterised by the January effect.

Table 6.11 : Discount First Differences

For each fund we measure the changes in the discount during the different months. The table shows the average discount first differences based on our sample of 244 funds. The results are shown as percentage values. Column [A] is the average of the non-January months. Column [B]-[A] is the difference between the changes during the month of January and the average value for the other months. Levels of significance for the test of the differences between the two means are denoted by *** (1% level ), ** (5% level) and * (10% level).

| | February | March | April | May | June | July | August | September | October | November | December | Non-Jan [A] | January [B] | [B]-[A] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Discount First Differences (%) | -0.31 | -0.39 | -0.26 | -0.16 | -0.16 | -0.16 | 0.36 | -0.58 | 0.09 | -0.51 | -0.24 | -0.21 | 0.01 | 0.23 |

## 8. Conclusion

The time-series analysis of UK closed-end funds shows interesting results. Discounts are highly autocorrelated in their levels but not in their first differences. Nevertheless, we find weak evidence of price reversal. The analysis also shows that UK closed-end funds have a tendency to return to their mean and fluctuate around it within a certain range. Furthermore, there is strong evidence of the UK closed-end fund discounts moving together.

Based on these results we identify two factors that are likely to be significant in the model of the discount generating process analysed in the next chapter: (i) discounts move together and (ii) discounts are characterised by some degree of time-series reversal.

Finally, we find no evidence of seasonality in the behaviour of the discount. Changes in the discount during the month of January are not significantly different from the other months.

# Chapter 7

# Model of the Discount Generating Process

## 1. Introduction

This chapter investigates the time-series behaviour of closed-end fund discounts and attempts to identify the factors that might affect the changes in the level of the discount. Based on the results of Pontiff (1997), we first take into account market risk, small firm risk, book-to-market risk and the risk that affects other closed-end funds. An attempt is made to explain at least part of the largely idiosyncratic movements in the discount by introducing additional factors. We investigate the importance of measures of mean-reversion (where the mean is the average discount of the category), price reversal, past performance and management. Finally, we consider the sensitivity to the local market factor and to different measures of past performance.

## 2. The Model

Pontiff (1997) shows that US closed-end fund monthly returns are 64 percent more volatile than their assets - the variance of UK closed-end fund returns is 58 percent greater than the variance of its portfolio returns (see Chapter 6). Pontiff argues that 15 percent of this excess volatility can be explained by market risk, small firm risk, book-to-market risk and the risk that affects other closed-end funds. Based on these observations, this chapter investigates the time-series behaviour of UK closed-end fund discounts and attempts to identify the factors that might affect the changes in the level of the discount.

The importance of market risk, book-to-market-risk and small firm risk in explaining cross-sectional differences in stock returns is discussed in Fama and French (1993). Pontiff (1997) adds a fourth factor to these three risk measures, 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) defines this sentiment measure as the return of a portfolio that is long in the closed-end fund shares and short in the underlying. Equation (4.5) shows that it corresponds to an index of changes in closed-end fund discounts. The cointegration analysis in Chapter 6 shows that discounts tend to move together and that the relationship is particularly strong within each category of fund. Therefore, for each category, we measure sentiment as the return on an equally-weighted index of changes in discounts, where we include all the funds in a category, with the exception of the fund under investigation.

Several papers suggest that discounts follow a mean-reverting process. Thompson (1978) and Pontiff (1995) argue that trading strategies based on the level of discount accrue abnormal returns. The results are less compelling for the UK market but Cheng, Copeland and O'Hanlon (1994) interpret the evidence as an apparent rejection of the semi-strong form of market efficiency. Chapter 6 shows the importance of mean-reversion for UK closed-end fund discounts. A model that attempts to describe the time-series behaviour of the discounts must, therefore, account for this pattern. If a fund is trading at a large/small discount compared to the average discount of the category, we would expect the discount to decrease/increase and revert towards this mean. We measure the category discount as the logarithm of the equally-weighted price to NAV ratios of all the funds in the category, excluding the fund of interest. The mean-reversion factor is defined as the difference between the category and the fund's past discount.

The cointegration analysis discussed in Chapter 6 shows that the fund's discount is affected by the behaviour of its category discount. However, the AITC categories might not be the only relevant classification. The conjecture is that management brand might influence the discounts of the funds under the same management. Therefore, for each management group, we measure the "manager" effect as the returns on an equally-weighted index of changes in the discount, where we include all the funds in the management group with the exception of the fund under investigation.

The results in Chapter 5 tend to suggest that discounts weakly reflect past performance. In order to capture more of the idiosyncratic changes in the discount, we introduce a past performance factor. We define past performance as the fund's NAV return[142] in excess of the category's NAV performance.

The analysis of the time-series behaviour of UK closed-end fund discounts also suggests the existence of weak negative autocorrelation both when discount changes are measured over one-month and one-year periods (see Section 4 and Section 3 of Chapter 6, respectively). The evidence suggests that the model of the discount generating process might need an additional factor capturing this price reversal effect. We refer to this measure as the "reversal" factor.

## 3. Data Description

For the entire UK closed-end fund industry, Datastream provides share price and undiluted NAV with prior charges valued at par. Discounts and returns are computed using monthly data from January 1981 to December 1996[143]. See Section 2 of Chapter 4 for the definition of the discount and index, share price and NAV monthly returns.

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[142] The fund performance is computed using the NAV because the share price is affected by fluctuations in the discount.

We investigate almost the entire UK investment trust industry, with the exception of funds that invest in unquoted securities (Venture & Development), specialist funds (Commodity & Energy and Property), Emerging Market funds, Split Capital trusts and dead funds[144]. The fourteen categories[145] under investigation cover 244 funds. We exclude the funds for which we have less than 18 months of data (42 funds were issued between July 1995 and December 1996). The overall sample includes 202 funds. Table 2.1 describes the categories. Table 6.1 details the individual funds and their management groups

We define the factors as follows. The market is the difference between the return on the FTSE 100 index and the risk-free rate. The small firm risk measure is the difference between the return on the Extended Hoare Govett Smaller Companies index and the return on the FTSE 100 index[146]. Similarly, the market-to-book risk measure is defined as the difference between the return on the FTSE 350 Growth index and the FTSE 350 Value index.

The "sentiment" factor is measured using an equally-weighted index of changes in discounts, where we include all the funds in a category except the fund of interest[147].

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[143] This interval was chosen because most of the data was available since 1981. We have acquired data that would allow us to go back to 1980 but, because this is not likely to change the results, we delay it to future research.

[144] The sample excludes dead funds because of some data limitations.

[145] Because of their small number and similarity to the funds in the Continental Europe category, we include the three funds of the Pan Europe category in the Continental Europe category.

[146] The FTSE 100 is used as a proxy for the return on large companies.

[147] The category discount is defined as the logarithm of the equally-weighted average price to NAV ratio. This sentiment measure excludes the funds during their first six month of trading. We

The mean-reversion factor is defined as the difference between the category and the fund discount. The equally-weighted average discount of the category is computed excluding the fund of interest.

We define the "manager" factor as the equally-weighted index of changes in the discount, where we include all the funds in the management group except the fund of interest[148]. We investigate the importance of the management brand for all groups managing at least 3 closed-end funds - 26 management groups managing a total number of 172 funds. The remaining 72 funds ( independent managers and one- or two-fund managers) are grouped into "large", "middle" and "small" size funds under management. In this way, every closed-end fund has a house-average discount as an independent variable[149].

The past performance factor is defined as the difference between the fund NAV return and the equally-weighted average NAV return of the category, where we exclude the fund of interest[150]. We refer to this measure as excess NAV returns. Past performance is measured over one-month periods to avoid the problem of overlapping observations. Finally, we define the "reversal" factor as the change in the discount during the previous period. All factors are described in Table 7.1 below.

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eliminate, therefore, the influence of premiums that correspond to underwriting fees and start-up costs.

[148] The management group discount is defined as the logarithm of the equally-weighted average price to NAV ratio. This measure excludes the funds during their first six months of trading in order to eliminate the influence of premiums that correspond to underwriting fees and start-up costs.

[149] Given this procedure, our results will underestimate the impact of management on the discount.

[150] The equally-weighted average NAV return of the category is computed if there are at least three funds trading in that category.

Table 7.1. Variables Description

The fund discount is defined as $d_t = ln\ (P_t\ \ NAV_t)$. The category discount is the logarithm of the equally-weighted average of the price to NAV ratio where we exclude the fund of interest. Index and NAV returns are expressed as total returns and are continuously compounded. Managerial returns are defined using returns-based style analysis.. The Extended Hoare Govett Smaller Companies index is taken from Dimson-Marsh (1997). FTSE International computes FTSE 350 Value and Growth indexes. All other indexes and closed-end fund share prices and NAVs are downloaded from Datastream. The upper panel describes the factors used in the main study. The lower panel shows the variables used in the sensitivity analysis (Section 7).

| Factors | Symbols | Definition of components of each factor | |
|---|---|---|---|
| **Main Study** | | | |
| Market | $R_{UK} - R_F$ | $R_{UK} - R_L$ | FTSE 100 index |
| | | $R_F$ | Risk free rate - UK 1 month Libor |
| Size | $R_S - R_L$ | $R_S$ | Extended Hoare Govett Smaller Companies index |
| | | $R_L = R_{UK}$ | FTSE 100 index |
| Market-to-Book | $R_G - R_V$ | $R_G$ | FTSE 350 Growth index |
| | | $R_V$ | FTSE 350 Value index |
| Sentiment | $D_{i,t} - D_{i,t-1}$ | $D_i$ | Discount of the AITC category i, excluding fund j |
| Mean-reversion | $D_{i,t-1} - d_{j,t-1}$ | $d_{j,t-1}$ | Discount of fund *j* in preceding time period |
| Manager | $D_{M\,h,t} - D_{Mh,t-1}$ | $D_{M\,h}$ | Discount of the management group h, excluding fund j |
| Reversal | $d_{j,t-1} - d_{j,t-2}$ | $d_{j,t-2}$ | Discount of fund *j* in period before last |
| NAV Performance | $R_{NAV\,j,t-1} - R_{NAV\,i,t-1}$ | $R_{NAV\,j}$ | NAV return of fund j |
| | | $R_{NAV,i}$ | NAV return of the category i, excluding fund j |
| **Sensitivity Analysis** | | | |
| Local Market | $R_{Local,t} - R_{World,t}$ | $R_{World}$ | MSCI World index |
| | | $R_{Local} = R_{US}$ | S&P 500 index |
| | | $= R_{Far\ East}$ | MSCI Pacific Basin excluding Japan index |
| | | $- R_{Japan}$ | MSCI Japan index |
| | | $= R_{Europe}$ | MSCI Europe excluding UK index |
| NAV Performance | $Rank_{NAV\ j,i}$ | $Rank_{NAV\ j,i}$ | Rank of fund j NAV return relative to its category i |
| | $R_{Managerial\ j,t-1} - R_{Managerial\ i,t-1}$ | $R_{Managerial\ j}$ | Managerial return of fund j |
| | | $R_{Managerial,i}$ | Managerial return of the category i, excluding fund j |

Consistent with the evidence illustrated in Table 6.8, the sentiment and the manager factors are not independent - the average correlation between the changes in the discount of the AITC category and the changes in the discount of the management group is 0.65. We therefore orthogonalise the manager factor by regressing the manager factor on the sentiment factor. The residuals from this simple regression are used as our measure of manager risk. Table 7.2 shows the average correlogram based on the 202-fund sample. The table shows that by orthogonalising the manager factor we have reduced the problem of collinearity between the independent variables.

Table 7.2. Correlogram of the Independent Variables in the Multi-Factor Regression

The table shows the correlation between the independent variables of the multi-factor regression described in Equation (7.4). We report the average correlation for the 202 funds and the corresponding t-statistics[151].

| | | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|
| | | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| Factor 1 | Market | -0.32 (-4.80) | 0.16 (2.26) | 0.00 (0.05) | 0.10 (1.35) | 0.00 (-0.01) | -0.04 (-0.58) |
| Factor 2 | Size | | 0.15 (2.12) | -0.01 (-0.17) | 0.08 (1.13) | -0.01 (-0.17) | 0.10 (1.42) |
| Factor 3 | Sentiment | | | -0.09 (-1.22) | 0.00 (0.00) | -0.04 (-0.54) | -0.04 (-0.56) |
| Factor 4 | Mean-reversion | | | | 0.03 (0.48) | 0.20 (2.93) | -0.27 (-3.94) |
| Factor 5 | Manager | | | | | 0.03 (0.35) | 0.00 (-0.03) |
| Factor 6 | NAV Performance | | | | | | -0.26 (-3.83) |

The significance test shows that most correlation coefficients are nonsignificant. However, we find that some factors are slightly correlated. This is important when we interpret the results in this chapter.

## 4. Methodology

We begin our methodology section by investigating the importance of Fama-French type factors in explaining returns and discount changes for UK closed-end funds. The results show that the factors explain closed-end fund share price and NAV returns, but not discount changes. We then introduce additional factors for the analysis of the discounts.

### 4.1. Fama -French regression

Fama and French (1993) show the importance of market risk, small firm and book-to-market risk in explaining cross-sectional differences in stock returns. Equations (7.1) and (7.2) test the significance of these three factors in relation to share price and NAV returns of UK closed-end funds, respectively. Equation (7.3) investigates discount first differences.

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[151] The t-statistics for the correlation coefficient is measured as follows:

$t = r_{x,y}\sqrt{N-2}\ /\ \sqrt{1-r_{x,y}^2}$ where $r_{x,y}$ is the correlation coefficient between discounts and returns. $N = 202$ observations.

$$R_{Price,t} = \beta_0 + \beta_1(R_{UK,t} - R_{F,t}) + \beta_2(R_{S,t} - R_{L,t}) + \beta_3(R_{G,t} - R_{V,t}) + \varepsilon_{j,t} \tag{7.1}$$

$$R_{NAV,t} = \beta_0 + \beta_1(R_{UK,t} - R_{F,t}) + \beta_2(R_{S,t} - R_{L,t}) + \beta_3(R_{G,t} - R_{V,t}) + \varepsilon_{j,t} \tag{7.2}$$

$$\Delta d_{j,t} = \beta_0 + \beta_1(R_{UK,t} - R_{F,t}) + \beta_2(R_{S,t} - R_{L,t}) + \beta_3(R_{G,t} - R_{V,t}) + \varepsilon_{j,t} \tag{7.3}$$

Table 7.3 shows the results based on the sample of 202 funds and using data from January 1987 to December 1996 (the FTSE 350 Growth and the FTSE 350 Value index are computed starting from January 1987). All variables are described in Table 7.1.

Following Pontiff (1997), we test the significance of the estimated coefficient, $\beta_K$ based on the following null hypotheses:

$$(1) \quad H_0: \quad \frac{1}{n}\sum_{i=1}^{n} \beta_{k,i} = 0$$

$$(2) \quad H_0: \quad \frac{1}{n}\sum_{i=1}^{n} t_{k,i} = 0$$

where $\beta_{K,i}$ is factor $k$ estimated coefficient from the regression for fund $i$. $t_{k,i}$ is the t-statistic of the estimated coefficient $\beta_{K,i}$. $n$ is the number of funds in a group or category. If we test the significance of the factor based on the entire sample of funds, $n$ is equal to 202[152].

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[152] In Table 7.6, reported later in this chapter, we test the robustness of the testing procedure

Table 7.3. The Multi-Factor Regression Using the Fama-French factors

The multi-factor regressions described in Equations (7.1), (7.2) and (7.3) measure the sensitivity of the share price returns, NAV returns and discount first differences, respectively, to the market, size and market-to-book factors. The regressions are estimated over the period January 1987 to December 1996 (the FTSE 350 Growth and Value index are available since January 1987). The sample covers 202 funds. The number of observations is the average number of monthly data available for the funds in each category. The coefficient is the equally-weighted average of the estimated coefficients from the 202 regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error).

| | | | | Factor 1 | Factor 2 | Factor 3 |
|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Market $(R_{UK} - R_F)$ | Size $(R_S - R_L)$ | Market-to-Book $(R_V - R_G)$ |
| PRICE Retuns | 47.09 | 78 | 0.00 | 0.97 | 0.61 | -0.02 |
| | | | (7.24) | (37.85) | (27.27) | (-0.75) |
| | | | {12.51} | {21.89} | {23.59} | {1.37} |
| NAVRetuns | 60.55 | 78 | 0.00 | 0.91 | 0.49 | -0.01 |
| | | | (11.63) | (42.57) | (21.40) | (-0.78) |
| | | | {16.79} | {18.59} | {17.41} | {1.03} |
| DISCOUNT Changes | 6.32 | 78 | 0.00 | 0.07 | 0.12 | -0.02 |
| | | | (-5.28) | (2.96) | (6.40) | (-0.66) |
| | | | {-3.85} | {6.90} | {9.14} | {1.58} |

The market, size and market-to-book factors explain both share price and NAV total returns. The results are particularly significant for NAV returns because NAVs are not affected by changes in the discount (the adjusted R-squared is 60.5 percent). The coefficient is the equally-weighted average of the estimated coefficients from the 202 regressions. We report in round brackets the t-statistic for the null hypothesis that the mean of the coefficients is equal to zero (the t-statistic is the average coefficient divided by its standard error across the 202 regressions). The t-statistic for the null hypothesis that the mean of the t-statistics is equal to zero is shown in braces (the t-statistic is computed as the mean t-statistic divided by its standard error across the 202 regressions).

The results show that the market and size factors are highly significant in explaining share price and NAV returns, whereas the market-to-book factor does not seem to have much power. In contrast, changes in the discount are much less sensitive to Fama and French-type (FF-type) factors (the average adjusted R-squared is 6.3 percent). The market and in particular the size factors appear to be significant in explaining changes in the discount. However, consistent with Pontiff (1997), we find that the market-to-book factor does not seem to have any explanatory power. Consequently, we exclude this factor from our analysis[153].

### 4.2. Multi-Factor Regression

It is not surprising to find that for the discount, essentially an arbitrage portfolio, factors other than the FF-type must be included. We investigate the importance of measures of sentiment, mean-reversion, management, past performance and price reversal.

Equation (7.4) describes the time-series behaviour of the discount. NAV and index returns are both expressed as total returns. All variables are described in Table 7.1.

$$\begin{aligned}\Delta d_{j,t} = d_{j,t} - d_{j,t-1} = \; & Dummy_{j,k} + \beta_0 + \beta_1 (R_{UK,t} - R_{F,t}) + \beta_2 (R_{S,t} - R_{L,t}) \\ & + \beta_3 (D_{i,t} - D_{i,t-1}) + \beta_4 (D_{i,t-1} - d_{j,t-1}) \\ & + \beta_5 (D_{Mh,t} - D_{Mh,t-1}) + \beta_6 (R_{NAVj,t-1} - R_{NAVi,t-1}) \\ & + \beta_7 (d_{j,t-1} - d_{j,t-2}) + \varepsilon_{j,t} \qquad (7.4)\end{aligned}$$

$$\text{where } Dummy_{j,k} = \begin{cases} 1 & \text{for } k = 1 \text{ to } 6 \text{ months after the IPO} \\ 0 & \text{elsewhere} \end{cases}$$

Closed-end funds typically trade at a substantial discount to NAV which fluctuates over time. The model of the discount generating process attempts to explain this behaviour. However, closed-end funds are characterised by a significant price decline during the first months of trading. The funds are issued at up to a 10 percent premium representing underwriting fees and start-up costs. Subsequently, within a matter of months, the shares trade at a discount (see Chapter 8). In order to adjust for the behaviour of the discount during the first months of trading, we introduce a dummy variable, $Dummy_{j,k}$, that takes value 1 during the first six months of trading and 0 in the following months.

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[153] The market-to-book index computed by FTSE-International is available only since 1987. Given its insignificance in terms of explaining the changes in the discount, we decided to exclude the factor and extend the analysis back to 1981.

## 5. Empirical Results

The extent and the diversity of the UK closed-end fund industry makes it difficult to analyse all funds as if they were an homogeneous group. Consequently, we need to measure the behaviour of each fund relative to its category, as defined by the AITC classification. We also analyse the importance of the management group.

The multi-factor regression methodology measures the sensitivity of the changes in the discount to the market, size, sentiment, mean reversion, manager, past performance and reversal factors.

### 5.1. The multi-factor regression

The multi-factor regression methodology described in Equation (7.4) measures the sensitivity of the changes in the discount to the market, size, sentiment, mean reversion, manager, past performance and reversal factor. Table 7.4 shows the average results for the AITC categories (Table A1 in the Appendix describes the results of the multi-factor regression for the individual funds in the categories). The results for the entire sample of 202 funds are described at the end of the table.

Table 7.4. Multi-Factor Regression - AITC Categories.

The multi-factor regression described in Equation (7.4) measures the sensitivity of the first differences in the discount to the market, size, sentiment, mean-reversion, manager, past performance and reversal factor. The regression is estimated over the period February 1981 to December 1996. The sample covers 202 funds. The number of observations is the average number of monthly data available for the funds in each category. For each AITC category, we define the coefficients as the equally-weighted average of the estimated coefficients from the regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error). At the bottom of the table we report the results based on the entire sample of 202 funds.

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| International General | 46.70 | 178 | -0.00<br>(-1.00)<br>{-1.61} | 0.00<br>(0.19)<br>{0.12} | 0.00<br>(0.04)<br>{0.34} | 0.04<br>(1.41)<br>{1.11} | 0.83<br>(27.12)<br>{11.33} | 0.17<br>(6.27)<br>{10.48} | 0.15<br>(3.28)<br>{2.93} | 0.30<br>(5.97)<br>{5.88} | -0.13<br>(-4.85)<br>{-4.54} |
| International Capital Growth | 40.53 | 137 | -0.00<br>(-0.08)<br>{-1.39} | 0.00<br>(0.30)<br>{0.10} | 0.01<br>(0.35)<br>{0.53} | 0.04<br>(1.08)<br>{1.37} | 0.90<br>(12.08)<br>{9.08} | 0.23<br>(10.24)<br>{14.00} | 0.17<br>(2.20)<br>{4.24} | 0.15<br>(3.41)<br>{4.95} | -0.07<br>(-2.82)<br>{-3.50} |
| International Income Growth | 44.19 | 191 | 0.00<br>(1.56)<br>{1.63} | -0.01<br>(-0.68)<br>{-0.63} | 0.06<br>(1.14)<br>{1.23} | 0.05<br>(1.94)<br>{1.95} | 0.61<br>(6.21)<br>{5.95} | 0.08<br>(6.89)<br>{10.68} | 0.18<br>(4.29)<br>{6.07} | 0.35<br>(5.87)<br>{9.73} | -0.18<br>(-3.30)<br>{-3.43} |
| UK General | 27.60 | 132 | -0.00<br>(-0.22)<br>{-0.19} | 0.00<br>(0.48)<br>{1.05} | -0.09<br>(-1.42)<br>{-1.06} | 0.04<br>(0.65)<br>{1.82} | 0.55<br>(4.78)<br>{5.36} | 0.16<br>(6.06)<br>{12.51} | 0.24<br>(2.91)<br>{2.90} | 0.18<br>(3.65)<br>{4.06} | -0.08<br>(-2.24)<br>{-2.04} |
| UK Capital Growth | 32.23 | 38 | -0.00<br>(-0.53)<br>{-0.86} | 0.02<br>(1.92)<br>{2.14} | 0.14<br>(1.14)<br>{1.02} | 0.19<br>(1.88)<br>{2.29} | 0.44<br>(2.43)<br>{1.80} | 0.32<br>(3.35)<br>{7.53} | 0.45<br>(3.97)<br>{3.00} | 0.14<br>(2.58)<br>{3.38} | -0.05<br>(-0.94)<br>{-0.89} |
| UK Income Growth | 32.23 | 139 | -0.00<br>(-0.29)<br>{-0.60} | -0.00<br>(-0.52)<br>{-0.54} | -0.04<br>(-1.07)<br>{-0.06} | 0.04<br>(0.92)<br>{0.73} | 0.69<br>(11.42)<br>{5.55} | 0.17<br>(7.92)<br>{9.81} | 0.14<br>(3.64)<br>{3.03} | 0.21<br>(2.54)<br>{3.44} | -0.10<br>(-2.58)<br>{-3.26} |
| High Income | 27.07 | 69 | -0.00<br>(-0.39)<br>{-0.69} | 0.01<br>(0.77)<br>{1.05} | -0.09<br>(-1.23)<br>{-1.19} | -0.08<br>(-0.80)<br>{-0.15} | 0.55<br>(6.57)<br>{7.01} | 0.32<br>(6.92)<br>{12.93} | 0.22<br>(1.65)<br>{2.66} | 0.01<br>(0.13)<br>{0.20} | -0.09<br>(-2.51)<br>{-2.81} |
| Closed-End Funds | 14.83 | 99 | -0.01<br>(-1.10)<br>{-1.46} | 0.00<br>(0.09)<br>{0.64} | -0.01<br>(-0.12)<br>{0.14} | 0.03<br>(0.33)<br>{0.26} | 0.11<br>(0.94)<br>{1.13} | 0.18<br>(2.55)<br>{4.33} | -0.10<br>(-0.59)<br>{-0.01} | -0.01<br>(-0.32)<br>{-0.03} | -0.08<br>(-2.02)<br>{-1.42} |
| Smaller Companies | 26.40 | 105 | -0.00<br>(-0.45)<br>{-0.68} | 0.02<br>(3.73)<br>{3.82} | 0.02<br>(0.55)<br>{0.45} | 0.02<br>(0.61)<br>{0.81} | 0.74<br>(13.86)<br>{11.66} | 0.20<br>(7.24)<br>{14.97} | 0.19<br>(3.28)<br>{4.13} | 0.16<br>(2.47)<br>{3.54} | -0.11<br>(-4.68)<br>{-4.49} |
| North America | 40.01 | 115 | -0.01<br>(-0.92)<br>{-0.69} | -0.01<br>(-0.66)<br>{-0.09} | 0.06<br>(0.88)<br>{1.17} | 0.14<br>(1.03)<br>{0.24} | 0.70<br>(7.38)<br>{4.70} | 0.27<br>(2.76)<br>{15.37} | -0.01<br>(-0.06)<br>{1.94} | 0.26<br>(2.42)<br>{2.56} | -0.06<br>(-1.30)<br>{-2.28} |
| Far East excluding Japan | 30.30 | 63 | -0.00<br>(-0.64)<br>{-0.86} | 0.00<br>(0.04)<br>{0.48} | 0.13<br>(2.52)<br>{2.79} | 0.13<br>(2.22)<br>{1.91} | 0.65<br>(7.56)<br>{7.02} | 0.30<br>(7.83)<br>{9.67} | 0.43<br>(3.54)<br>{3.95} | 0.15<br>(3.55)<br>{3.62} | -0.13<br>(-4.45)<br>{-4.80} |
| Far East including Japan | 43.13 | 153 | 0.01<br>(0.84)<br>{0.04} | 0.01<br>(0.37)<br>{0.62} | 0.21<br>(1.87)<br>{3.28} | 0.03<br>(0.80)<br>{1.16} | 0.75<br>(9.69)<br>{5.26} | 0.32<br>(2.48)<br>{19.76} | 0.22<br>(2.24)<br>{2.51} | 0.12<br>(2.08)<br>{3.36} | -0.02<br>(-0.13)<br>{-1.98} |
| Japan | 54.65 | 85 | -0.00<br>(-0.13)<br>{-0.42} | 0.02<br>(2.02)<br>{3.45} | -0.03<br>(-0.61)<br>{-0.41} | -0.09<br>(-1.33)<br>{-1.52} | 0.81<br>(20.07)<br>{7.68} | 0.38<br>(4.06)<br>{6.61} | 0.12<br>(1.22)<br>{1.99} | 0.25<br>(6.04)<br>{5.37} | -0.10<br>(-2.56)<br>{-2.73} |
| Continental Europe | 37.86 | 108 | -0.00<br>(-0.82)<br>{-0.64} | 0.01<br>(0.98)<br>{1.09} | 0.00<br>(0.04)<br>{0.63} | 0.03<br>(0.90)<br>{1.39} | 0.75<br>(10.69)<br>{7.82} | 0.24<br>(10.90)<br>{14.16} | 0.11<br>(1.99)<br>{2.17} | 0.19<br>(2.48)<br>{4.12} | -0.09<br>(-3.03)<br>{-3.40} |
| **Average** | **34.73** | **111** | **0.00<br>(-1.60)<br>{ 2.88}** | **0.01<br>(2.83)<br>{3.53}** | **0.02<br>(1.37)<br>{1.68}** | **0.04<br>(2.77)<br>{3.45}** | **0.70<br>(29.76)<br>{20.07}** | **0.24<br>(19.23)<br>{37.65}** | **0.20<br>(7.77)<br>{11.16}** | **0.17<br>(9.71)<br>{12.63}** | **-0.09<br>( 10.40)<br>{-11.61}** |

For each category of fund, we present the equally-weighted average of the estimated coefficients from the regressions. In round brackets we report the t-statistic for the null hypothesis that the mean of the coefficients is equal to zero (the t-statistic is the average coefficient divided by its cross-sectional standard error). The t-statistic for the null hypothesis that the mean of the t-statistics is equal to zero is shown in braces (the t-statistic is computed as the mean t-statistic divided by its cross-sectional standard error). t values may be more informative than the estimated coefficients if the standard error of the coefficients vary. The results are shown for each category of funds and for the entire sample of 202 funds.

Consistent with Pontiff (1997), the size factor appears to be significant in explaining the changes in the discount. The mean coefficient for the entire sample (0.04) is significant at the 1 percent level. The dummy is also significant at a similar level. In contrast, the market factor does not seem to have any significant explanatory power.

The analysis of the sentiment risk, as defined by the changes in the category discount, shows that changes in the discount are largely driven by the behaviour of the category. The results show that an increase in the discount of the category is associated with an increase in the discount of the fund. Based on the entire sample, the average sensitivity to the sentiment factor is 0.7. The t-statistic for the mean coefficient is highly significant (t-value of 29.76). The equivalent result using t-values is characterised by a lower t-statistic, but always highly significant (t-value of 20.07). With the exception of UK Capital Growth and Closed-End Funds categories, the t-statistic for both the mean coefficient and the mean t values are significant at the 1 percent level for all categories. The result is consistent with the evidence of cointegration discussed in Chapter 6.

The mean-reversion factor is also very significant in explaining the changes in the discount. The larger the difference between the category and the fund discount, the larger the price correction towards the mean. If the fund trades at a larger discount than the average for the category, the fund discount tends to decrease (implying that the logarithm of the price to NAV ratio increases). Based on the entire sample, the average estimated coefficient for the mean-reversion factor (0.24) is significant at the 1 percent level.

The results for the manager factor show that an increase in the discount of the management group (the average discount of the funds managed by the same group) is associated with an increase in the discount of the fund. Based on the entire sample, the sensitivity to the "brand" of the management group is 0.24. Both the t-statistic for the mean coefficient and the mean t-values are significant at the 1 percent level. The results suggest that the performance of the other funds under the same management affect the discount of the fund.

The orthogonalisation procedure makes it impossible to compare the significance of the manager factor with the sentiment factor. For that, we need to run the multi-factor regression with the factors taken one at the time. We find that the sentiment factor has a higher explanatory power than the manager factor. The results tend to suggest that the discounts are more sensitive to their AITC category, rather than to their management group. The results is, however, not surprising, given that our measure of the house-average discount is likely to underestimate the importance of the management on the discount.

Past performance, defined as the difference between the fund NAV return and the equally-weighted average NAV return of the category, where we exclude the fund of interest, has some explanatory power for most of the categories (the exceptions are the High Income and Closed-End Funds categories). An increase in our measure of excess past performance is associated with an increase in the logarithm of the price to NAV ratio (corresponding to a decrease in the level of the discount - see Section 2 of Chapter 4). This implies that if the performance of the fund during the previous month had been good relative to its peers in the category, its discount will tend to decrease.

Based on the entire sample, the average slope for the past performance factor is 0.17. The t-statistic for the mean coefficient is significant at the 1 percent level (9.71). The results using t-values are characterised by an even higher t-statistic (12.63).

The analysis of the reversal factor shows that an increase in the discount during the previous month is associated with a decrease in the discount in the following period. The estimated coefficient using the entire sample is -0.09. The results based on the entire sample of 202 funds are significant at the 1 percent level.

This model of the discount generating process seems to capture a significant fraction of the changes in the discount. The adjusted R-squared is higher than 40 percent for the International General, International Capital Growth, International Income Growth, North America, Far East including Japan and Japan categories. The seven factors explain, on average, 34.7 percent of the changes in the discount, whereas the value-weighted average adjusted R-squared is 37.9 percent.

## 5.2. The management group

The results from the multi-factor regressions have shown the importance of the manager factors in explaining changes in the discount. The analysis has measured the sensitivity to this factor for the entire sample and for all AITC categories. This section investigates whether for some management groups the manager factor is more significant. The idea is to identify the groups for which the "management brand" has a stronger effect on the discount of the funds under management. Table 7.5 shows the results (the management groups are sorted by the value of the estimated coefficient for the manager factor).

Table 7.5. Multi-Factor Regression - Management Groups.

The multi-factor regression described in Equation (7.4) measures the sensitivity of the first differences in the discount to the market, size, sentiment, mean-reversion, manager, past performance and reversal factors. The regression is estimated over the period February 1981 to December 1996. The number of observations is the average number of monthly data available for the funds in each category. For each management group, we define the coefficients as the equally-weighted average of the estimated coefficients from the regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error). The sample covers 26 management groups. Management groups are sorted by the level of the estimated coefficient for the manager factor.

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Managers (sorted by estimated factor 5) | Adjusted R-squared | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| M&G | 53.23 | 54 | 0.00<br>(1.22)<br>{1.12} | 0.07<br>(2.51)<br>{3.33} | -0.01<br>(-0.07)<br>{-0.26} | 0.03<br>(0.12)<br>{-0.12} | 0.34<br>(0.62)<br>{0.49} | 0.24<br>(2.58)<br>{5.27} | 0.59<br>(2.56)<br>{14.91} | -0.05<br>(-0.22)<br>{0.03} | -0.02<br>(-0.10)<br>{-0.05} |
| Edinburgh Fund Managers | 34.32 | 128 | -0.00<br>(-0.60)<br>{-0.90} | 0.02<br>(1.38)<br>{0.83} | 0.08<br>(1.98)<br>{0.68} | 0.00<br>(-0.01)<br>{0.60} | 0.55<br>(5.56)<br>{4.06} | 0.18<br>(4.85)<br>{6.46} | 0.43<br>(2.64)<br>{3.82} | 0.23<br>(4.48)<br>{4.55} | -0.15<br>(-6.95)<br>{-4.76} |
| Kleinwort Benson | 31.27 | 142 | 0.00<br>(0.62)<br>{-0.35} | 0.00<br>(0.59)<br>{0.44} | 0.10<br>(1.28)<br>{0.99} | 0.01<br>(0.08)<br>{0.18} | 0.67<br>(4.20)<br>{3.24} | 0.15<br>(7.05)<br>{5.71} | 0.41<br>(2.19)<br>{2.25} | 0.20<br>(24.63)<br>{10.48} | -0.02<br>(-0.40)<br>{-1.01} |
| Finsbury | 28.86 | 130 | 0.02<br>(1.00)<br>{0.77} | -0.02<br>(-1.76)<br>{-1.89} | -0.17<br>(-4.29)<br>{-1.69} | 0.15<br>(8.40)<br>{2.43} | 1.02<br>(3.41)<br>{3.49} | 0.17<br>(2.15)<br>{3.09} | 0.41<br>(0.94)<br>{0.44} | 0.04<br>(0.23)<br>{1.31} | 0.08<br>(4.20)<br>(2.14) |
| Fleming | 37.20 | 157 | -0.00<br>(-0.78)<br>{-0.74} | 0.00<br>(0.70)<br>{0.77} | 0.05<br>(1.30)<br>{1.21} | 0.05<br>(1.67)<br>{1.48} | 0.71<br>(12.34)<br>{6.28} | 0.13<br>(4.54)<br>{8.58} | 0.37<br>(4.75)<br>{4.56} | 0.27<br>(5.38)<br>{5.44} | -0.14<br>(-4.57)<br>{-4.46} |
| Govett (John) | 43.00 | 78 | -0.03<br>(-2.16)<br>{-2.92} | 0.01<br>(0.65)<br>{0.47} | 0.09<br>(2.37)<br>{2.54} | 0.11<br>(0.83)<br>{0.42} | 0.56<br>(2.12)<br>{2.45} | 0.46<br>(3.73)<br>{6.07} | 0.34<br>(2.86)<br>{4.18} | -0.01<br>(-0.11)<br>{0.48} | -0.08<br>(-1.26)<br>{-1.82} |
| Foreign&Colonial | 39.14 | 137 | 0.01<br>(1.16)<br>{0.41} | 0.01<br>(0.98)<br>{1.01} | 0.10<br>(2.23)<br>{3.73} | -0.01<br>(-0.15)<br>{0.39} | 0.67<br>(8.20)<br>{3.97} | 0.20<br>(6.08)<br>{9.61} | 0.30<br>(2.16)<br>{3.11} | 0.14<br>(2.10)<br>{2.45} | -0.16<br>(-5.06)<br>{-3.18} |
| Ivory&Sime | 32.34 | 139 | -0.01<br>(-1.27)<br>{-0.81} | 0.02<br>(1.30)<br>{1.60} | -0.01<br>(-0.11)<br>{1.19} | 0.05<br>(0.80)<br>{0.61} | 0.78<br>(8.32)<br>{5.02} | 0.23<br>(2.62)<br>{9.04} | 0.25<br>(2.89)<br>{6.23} | -0.02<br>(-0.10)<br>{0.70} | -0.10<br>(-2.48)<br>{-2.27} |
| Glasgow Investment Mana | 33.33 | 82 | -0.01<br>(-2.69)<br>{-3.60} | 0.02<br>(0.99)<br>{1.05} | -0.18<br>(-1.11)<br>{-1.06} | 0.01<br>(0.07)<br>{0.23} | 0.60<br>(8.16)<br>{7.83} | 0.16<br>(2.65)<br>{2.65} | 0.25<br>(4.18)<br>{3.76} | -0.01<br>(-0.04)<br>{-0.24} | -0.19<br>(-2.65)<br>{-2.42} |
| Murray Johnstone | 38.24 | 147 | -0.00<br>(-1.01)<br>{-0.07} | -0.01<br>(-0.45)<br>{-0.51} | 0.01<br>(0.17)<br>{0.91} | 0.01<br>(0.35)<br>{-0.21} | 0.93<br>(8.98)<br>{3.56} | 0.19<br>(4.58)<br>{14.71} | 0.24<br>(2.46)<br>{5.46} | 0.17<br>(2.17)<br>{2.31} | -0.10<br>(-2.25)<br>{-2.22} |
| Henderson Investors | 34.60 | 140 | 0.00<br>(1.25)<br>{0.90} | 0.01<br>(1.48)<br>{1.83} | 0.00<br>(0.11)<br>{0.48} | 0.04<br>(1.23)<br>{0.95} | 0.70<br>(11.07)<br>{7.61} | 0.22<br>(4.71)<br>{15.35} | 0.24<br>(3.04)<br>{3.54} | 0.12<br>(1.48)<br>{3.45} | -0.10<br>(-2.47)<br>{-2.80} |
| Abtrust | 30.99 | 65 | -0.01<br>(-2.37)<br>{-2.27} | 0.01<br>(0.91)<br>{0.87} | 0.14<br>(2.12)<br>{2.34} | 0.00<br>(-0.01)<br>{0.63} | 0.72<br>(5.73)<br>{4.30} | 0.34<br>(6.80)<br>{9.51} | 0.21<br>(1.21)<br>{1.02} | 0.35<br>(4.33)<br>{6.12} | -0.06<br>(-4.03)<br>{-3.58} |
| Martin Currie | 37.05 | 133 | 0.00<br>(1.08)<br>{0.65} | 0.00<br>(-0.07)<br>{0.31} | 0.01<br>(0.20)<br>{0.84} | 0.03<br>(0.96)<br>{0.37} | 0.71<br>(8.92)<br>{5.09} | 0.27<br>(2.28)<br>{7.66} | 0.20<br>(2.60)<br>{3.38} | 0.29<br>(5.56)<br>{4.47} | -0.07<br>(-1.13)<br>{-2.17} |
| Morgan Grenfell | 36.14 | 147 | -0.01<br>(-1.43)<br>{-1.67} | 0.01<br>(1.90)<br>{1.62} | -0.01<br>(-0.06)<br>{0.56} | 0.02<br>(1.02)<br>{0.80} | 0.68<br>(10.72)<br>{3.14} | 0.19<br>(3.17)<br>{9.42} | 0.17<br>(26.15)<br>{2.96} | 0.38<br>(16.68)<br>{2.64} | -0.16<br>(-5.52)<br>{-11.09} |
| Exeter Asset Management | 25.50 | 70 | 0.01<br>(0.55)<br>{0.36} | -0.04<br>(-0.62)<br>{-0.13} | -0.26<br>(-1.10)<br>{-1.15} | -0.31<br>(-7.53)<br>{-10.12} | 0.43<br>(3.85)<br>{3.73} | 0.20<br>(6.03)<br>{13.05} | 0.17<br>(2.83)<br>{2.87} | -0.04<br>(-0.72)<br>{-0.36} | -0.08<br>(-2.45)<br>{-2.36} |
| Schroder | 26.48 | 38 | 0.02<br>(2.39)<br>{1.74} | 0.03<br>(1.49)<br>{1.13} | 0.04<br>(0.75)<br>{0.67} | 0.12<br>(0.65)<br>{0.18} | 0.62<br>(5.54)<br>{2.65} | 0.36<br>(2.30)<br>{2.65} | 0.17<br>(1.90)<br>{1.88} | 0.00<br>(0.04)<br>{0.41} | -0.15<br>(-1.51)<br>{-1.51} |
| Baillie Gifford | 48.63 | 162 | -0.00<br>(-0.50)<br>{-0.48} | 0.01<br>(0.52)<br>{0.67} | -0.04<br>(-0.56)<br>{-0.13} | -0.04<br>(-1.46)<br>{-1.56} | 0.90<br>(22.38)<br>{7.20} | 0.20<br>(5.43)<br>{8.03} | 0.14<br>(2.82)<br>{2.47} | 0.28<br>(4.58)<br>{5.13} | -0.08<br>(-2.00)<br>{-1.80} |

Table 7.5. Multi-Factor Regression - Management Groups (Cont'd).

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Managers (sorted by estimated factor 5) | Adjusted R-squared | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| Gartmore | 29 03 | 95 | -0 00<br>(-0 61)<br>{-0 23} | 0 00<br>(0 60)<br>{0 84} | -0.18<br>(-2.14)<br>{-1 31} | -0 08<br>(-1 00)<br>{-0 61} | 0 62<br>(5 24)<br>{3 27} | 0 18<br>(5 75)<br>{5 01} | 0 12<br>(0 86)<br>{1 76} | 0 08<br>(0 78)<br>{1 94} | -0 17<br>(-2 60)<br>{-2 96} |
| Hill Samuel | 36.33 | 71 | -0 01<br>(-1 54)<br>{-1.14} | 0 04<br>(2 25)<br>{2.23} | 0 02<br>(0 15)<br>{0 23} | 0 07<br>(1 17)<br>{1 24} | 0 82<br>(10 35)<br>{9 89} | 0 24<br>(8 48)<br>{6 42} | 0 11<br>(2 44)<br>{2 46} | 0 18<br>(4 63)<br>{2 65} | -0 07<br>(-6 02)<br>{-5 34} |
| Fidelity | 59.22 | 29 | -0 01<br>(-0 77)<br>{-0 75} | -0 03<br>(-0 72)<br>{-0.52} | 0 13<br>(0 51)<br>{0 44} | -0 11<br>(-0 62)<br>{-0 36} | 0 76<br>(36 18)<br>{2 43} | 0 34<br>(1 51)<br>{1 66} | 0 06<br>(2 27)<br>{1 62} | 0 38<br>(3 08)<br>{2 75} | -0 11<br>(-0 73)<br>{-1 07} |
| Scottish Value | 25 77 | 37 | 0 01<br>(10 66)<br>{6 71} | 0 03<br>(2 08)<br>{2 49} | 0 12<br>(1 33)<br>{1 87} | 0 14<br>(5 87)<br>{3 29} | 0 04<br>(0 19)<br>{0 41} | 0 40<br>(3 38)<br>{3 75} | 0 06<br>(0 72)<br>{0 15} | -0 04<br>(-0 61)<br>{-0 67} | -0 21<br>(-4 82)<br>{-4 53} |
| Perpetual | 46 77 | 39 | 0 01<br>(15 10)<br>{4 13} | 0 01<br>(0 67)<br>{0.31} | -0 04<br>(-0 37)<br>{-0 44} | -0 05<br>(-0 14)<br>{-0.24} | 0 68<br>(1 92)<br>{1 25} | 0 13<br>(6 49)<br>{49 52} | 0 03<br>(0 20)<br>{0 04} | 0 65<br>(1 48)<br>{3 68} | 0 04<br>(0 20)<br>{-0 10} |
| Rutherford | 26.51 | 35 | -0 01<br>(-1 38)<br>{-1 97} | 0 02<br>(4 70)<br>{2.12} | 0 01<br>(0 05)<br>{-0 43} | -0 03<br>(-0 81)<br>{-0 55} | 0 91<br>(3 45)<br>{2 44} | 0 19<br>(3 05)<br>{8 35} | 0 03<br>(0 44)<br>{0 30} | 0 02<br>(0 07)<br>{0 01} | -0 26<br>(-4 16)<br>{-6 40} |
| INVESCO | 30.82 | 77 | -0 00<br>(-1 08)<br>{-1 02} | 0 01<br>(0 69)<br>{0 43} | 0 03<br>(0 30)<br>{-0 40} | 0 01<br>(0 07)<br>{-0 64} | 0 73<br>(6 78)<br>{5.96} | 0 37<br>(3 52)<br>{9 65} | 0 03<br>(0 15)<br>{0 25} | 0 28<br>(2.00)<br>{2.14} | -0 08<br>(-2 01)<br>{-1 23} |
| Jupiter | 16 78 | 61 | -0 01<br>(-1 18)<br>{-0 91} | 0 00<br>(0 00)<br>{-0 29} | -0 03<br>(-0 20)<br>{0 05} | 0 04<br>(0 26)<br>{0 21} | 1.01<br>(10 45)<br>{5 62} | 0 27<br>(17 07)<br>{8 40} | -0 02<br>(-0.31)<br>{-0 41} | 0 13<br>(0 82)<br>{1 09} | 0 03<br>(0 60)<br>{0 75} |
| Stewart Ivory | 37 19 | 58 | 0 01<br>(0 56)<br>{-0 59} | 0 01<br>(3 42)<br>{2 20} | 0 08<br>(2.51)<br>{1 24} | -0 05<br>(-2.16)<br>{-2.62} | 0 87<br>(17 37)<br>{2 98} | 0 37<br>(2 37)<br>{2.27} | -0 09<br>(-1 60)<br>{-1 85} | 0 31<br>(2.21)<br>{1 56} | -0 19<br>(-3 19)<br>{-4 03} |

For fifteen management groups - M&G, Edinburgh Fund Managers, Kleinworth Benson, Fleming, Govett, Foreign & Colonial, Ivory&Sime, Glasgow Investment Managers, Murray Johnstone, Henderson Investors, Martin Currie, Morgan Grenfell, Exeter Asset Management, Baillie Gifford and Hill Samuel - we find a significant estimated slope for the manager factor. Both the t-statistic for the mean coefficient and the mean t-value are significant at the 5 percent level. The results suggest that for these management groups the performance of the "manager" has a stronger impact on the discount of the funds under management.

## 6. Robustness of Testing Procedure

We analyse the robustness of the testing procedure by focusing on the 72 funds that have a full history of 191 months of observations. We use three different testing procedures. The first two - the t-statistic for the null hypothesis that the mean of the coefficients is equal to zero and the t-statistic for the null hypothesis that the mean of the t-statistics is equal to zero - are described in the previous sections. We report the values in parentheses and in braces, respectively. The third testing procedure is the average of the t-statistics in each of the single-trust regressions. This measure is reported in square brackets. Table 7.6 below presents the equally-weighted average of the estimated coefficients from the 72 regressions, alongside the results of the testing procedures.

A comparison with the results based on the entire sample of 202 funds (end of Table 7.4) shows that the full-history sample is characterised by a higher average adjusted R-squared, 37.4 percent. It is not surprising to find that, using funds with a full history, the model of the discount generating process improves. However, based on a smaller cross-section of funds, the t-values from the first two testing procedures tend to be lower. Nevertheless, our conclusions are unaffected and all factors with the exception of the market are still significant.

Table 7.6. Multi-Factor Regression - Full history funds.

The multi-factor regression described in Equation (7.4) measures the sensitivity of the first differences in the discount to the market, size, sentiment, mean-reversion, manager, past performance and reversal factor. The regression is estimated over the period February 1981 to December 1996. The sample covers the 72 funds with a full history of 191 observations. We define the coefficients as the equally-weighted average of the estimated coefficients from the regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error. In square brackets, we report the average t-statistic.

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| Average | 37.36 | 191 | 0.00<br>(-0.07)<br>{-1.07}<br>[-0.22] | 0.00<br>(-1.35)<br>{-0.99}<br>[-0.10] | 0.02<br>(1.22)<br>{1.48}<br>[0.47] | 0.03<br>(2.02)<br>{1.97}<br>[0.33] | 0.67<br>(22.15)<br>{17.54}<br>[7.24] | 0.14<br>(15.57)<br>{25.01}<br>[3.27] | 0.20<br>(9.29)<br>{9.86}<br>[1.91] | 0.24<br>(12.49)<br>{12.98}<br>[1.96] | -0.13<br>(-11.09)<br>{-10.96}<br>[-2.17] |

The third testing method, the average t-statistic, understates the significance of the factors. However, with the exception of size, we still find that all factors are characterised by an average t-statistic which is higher than the critical 10 percent level of significance. For the sentiment and mean-reversion factors, the results are significant at the 1 percent level. The results indicate that sentiment, mean-reversion, manager, past performance and reversal are indeed significant factors in explaining changes in the discount.

## 7. Sensitivity Analysis

This section analyses the sensitivity of the model of the discount generating process to different variables. First, we introduce a factor measuring the exposure to the market where the assets are invested, referred to as the local or 'home' market. Then we investigate different definitions of past performance - past NAV returns, rank and managerial performance - and compare them to our measure of excess NAV returns. Finally, we test whether the results from the multi-factor regressions are related to some seasonality in the behaviour of the discount.

### 7.1. The local market factor

Some of the categories contain funds that invest the majority of their assets in single geographical areas other than the UK market. It is therefore interesting to introduce an additional factor measuring the sensitivity to this market, where most of the underlying assets are traded. We refer to this market as the local or 'home' market. Equation (7.5) describes the multi-factor regression:

$$\begin{aligned}\Delta d_{j,t} = d_{j,t} - d_{j,t-1} = \; & Dummy_{j,k} + \beta_0 + \phi\,\beta_1 (R_{Local,t} - R_{World,t}) + \beta_2 (R_{UK,t} - R_{F,t}) \\ & + \beta_3 (R_{S,t} - R_{L,t}) + \beta_4 (D_{I,t} - D_{I,t-1}) + \beta_5 (D_{I,t-1} - d_{j,t-1}) \\ & + \beta_6 (D_{Mh,t} - D_{Mh,t-1}) + \beta_7 (R_{NAVj,t-1} - R_{NAVI,t-1}) \\ & + \beta_8 (d_{j,t-1} - d_{j,t-2}) + \varepsilon_{j,t} \qquad (7.5)\end{aligned}$$

$$\text{where } Dummy_{j,k} = \begin{cases} 1 & \text{for } k = 1 \text{ to 6 months after the IPO} \\ 0 & \text{elsewhere} \end{cases}$$

and $\phi$ is a binary variable = 1 for a number of categories - North America, Far East excluding Japan, Japan and Continental Europe. Table 7.7 shows the results.

For these four categories, more than 80 percent of the funds' assets are invested in the 'home' market. The introduction of the local market factor increases the adjusted R-squared for all categories with the exception of Continental Europe. However, the estimated coefficient of the local market factor is not significantly different from zero (with the exception of the North America category). Furthermore, for most categories the estimated coefficient for the local market is lower than for the UK market.

Table 7.7. Multi-Factor Regression Introducing the Foreign Market Index.

The multi-factor regression described in Equation (7.5) measures the sensitivity of the first differences in the discount to the local market, the UK market, size, sentiment, mean-reversion, manager, past performance and reversal factor. The local market measure is defined as the S&P 500 index for the North America category, the MSCI Pacific Basin excluding Japan index for the Far East excluding Japan category, the MSCI Japan index for the Japan category and the MSCI Europe excluding UK index for the Continental Europe category. The regression is estimated over the period February 1981 to December 1996. The number of observations is the average number of monthly data available for the funds in each category. For each category, we define the coefficients as the equally-weighted average of the estimated coefficients from the regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error).

|  |  |  |  |  | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 | Factor 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Adjusted R-squared (%) | Obs | Intercept | Dummy | Local Market | UK Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| North America | 40 57 | 115 | -0 01<br>(-0 91)<br>{-0 44} | -0 00<br>(-0 03)<br>{0 21} | -0 23<br>(-2 12)<br>{-2 67} | 0 07<br>(0 75)<br>{1 54} | 0 10<br>(0 79)<br>{0 11} | 0 58<br>(4 71)<br>{4 22} | 0 27<br>(2 58)<br>{11 83} | 0 02<br>(0 13)<br>{2 02} | 0 25<br>(2 68)<br>{2 71} | -0 06<br>(-1 22)<br>{-2 36} |
| Far East excluding Japan | 31 22 | 63 | -0.00<br>(-0 48)<br>{-0 70} | -0 00<br>(-0 05)<br>{-0 55} | 0 02<br>(0 30)<br>{0 13} | 0 10<br>(1 31)<br>{1 91} | 0.12<br>(1 76)<br>{1 62} | 0 64<br>(7 20)<br>{6 94} | 0 30<br>(6 87)<br>{9 39} | 0 44<br>(3 67)<br>{4 13} | 0 15<br>(2 53)<br>{3 31} | -0 13<br>(-3 27)<br>{-4 17} |
| Japan | 56 37 | 83 | 0 00<br>(0 32)<br>{-0 02} | 0 02<br>(2 40)<br>{3 69} | 0 01<br>(0 31)<br>{0 37} | -0 03<br>(-0 73)<br>{0 36} | -0 08<br>(-1 22)<br>{-1 42} | 0 83<br>(22 19)<br>{7 02} | 0 42<br>(4 59)<br>{6 82} | 0 14<br>(1 53)<br>{2 75} | 0 22<br>(4 68)<br>{4 07} | -0 09<br>(-2 39)<br>{-2 82} |
| Continental Europe | 37 28 | 108 | -0 00<br>(-0 69)<br>{-0 52} | 0 02<br>(1 37)<br>{1 48} | -0 02<br>(-1 10)<br>{-0 61} | 0 00<br>(-0 02)<br>{0 68} | 0 04<br>(1 05)<br>{1 52} | 0 75<br>(10 23)<br>{7 78} | 0.25<br>(10 90)<br>{14 64} | 0 10<br>(1 91)<br>{2 11} | 0 19<br>(2.51)<br>{4 09} | -0.09<br>(-3 06)<br>{-3 46} |

Despite the insignificance of both the local market and the UK market factors, the evidence tends to suggest that closed-end funds act more like securities of the market where they are traded, the UK market, rather than of the market where their assets are invested. The result is consistent with Chang, Eun and Kolodny's (1995) evidence that

US traded closed-end funds exhibit significant exposure to the US market and act more like US securities than do their underlying assets.

## 7.2. Past performance based on NAV returns

The multi-factor regression described in Equation (7.4) attempts to explain the behaviour of the discount using excess NAV returns as a measure of past performance. In this section we investigate different definitions of past performance - raw NAV returns and the rank. In Equation (7.4) we substitute the past performance factor, factor six, with the alternative measures. The two measures are defined as $R_{NAV\,t\text{-}1,\,j}$ for the raw returns and $Rank_{NAV\,t\text{-}1,\,Category}$ for the rank of the past NAV return of the fund relative to the performance of the other funds in the same category. Performance measures are computed over one-month periods to avoid the problem of overlapping observations.

Table 7.8 reports the results using the three different measures of past performance. The first measure is excess NAV returns, defined as the difference between NAV returns for fund *j* and the average NAV returns of the category where we exclude the fund of interest (Panel A). The results are repeated from Table 7.4. The second measure is past NAV return (Panel B). The third measure is the rank of the fund's NAV return relative to the NAV performance of the other funds in the category (Panel C). Following Rockinger (1995) we attribute a rank of 1 to the highest NAV return in the category.

Table 7.8 shows the result of the multi-factor regression for the International General category[154]. The comparison of the three measures shows that excess NAV returns

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[154] We report the results for the category that represents the major player in the sector. 40 percent of the UK investment trust companies are included in the FTSE All-Share index, whereas 80 percent of the funds in the International General category are part of the index. Furthermore, the International General category represents 10 percent of the number of funds included in the index, but 28 percent in terms of market capitalisation.

(Panel A) is characterised by the highest adjusted R-squared (46.70 percent). The average sensitivity to the excess NAV returns factor, 0.30, is significant at the 1 percent level. Panel B shows that the multi-factor regression using past NAV returns as a measure of past performance is characterised by a lower estimated coefficient (0.04). The t-statistics for both the mean coefficient and the mean t values are significant at the 1 percent level. However, the t-statistics are lower than the corresponding values for the excess NAV returns. The measure of past rank (Panel C) is characterised by an R-squared higher than using past NAV returns (46.07 percent), but lower than using excess NAV returns. The estimated coefficient is significant at the 1 percent level[155]. For brevity, we report only the results for the International General category. However, the results are similar across all categories.

The analysis shows that excess NAV returns is the most important performance measure explaining changes in the discount. The results tend to suggest that the performance relative to the peers in the group is more significant than past NAV returns. Furthermore, we find that excess NAV returns is better than the rank. The evidence contradicts Rockinger's (1995) claim that the rank is the most relevant performance measure.

The results of the multi-factor regression introducing one- and two-month lags between changes in the discount and past performance (excess NAV performance measured over one-month periods) show that the past performance factor becomes insignificant[156].

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[155] The difference in sign of coefficient for the past rank factor is due to the fact that the highest NAV return is given a rank of 1, the lowest value.

[156] The results are available from the author.

Table 7.8. Multi-Factor Regression Using different measures of past performance based on NAV returns - International General category (INGN).

The multi-factor regression described in Equation (7.4) measures the sensitivity of the first differences in the discount to the market, size, sentiment, mean-reversion, manager, past performance and reversal factors. The table shows the results using two different measures of past monthly NAV performance. Panel A shows the results using NAV returns as a measure of past performance. Panel B shows the results using the rank of past NAV returns. The regression is estimated over the period February 1981 to December 1996. The number of observations is the average number of monthly data available for the funds in the International General category. For the International General category (INGN), we define the coefficients as the equally-weighted average of the estimated coefficients from the regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error).

Panel A : Past Excess NAV Returns

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | Past Performance Excess NAV return | Reversal |
| International General | 46 70 | 178 | -0 00<br>(-1 00)<br>{-1 61} | 0 00<br>(0 19)<br>{0 12} | 0 00<br>(0 04)<br>{0 34} | 0 04<br>(1.41)<br>{1.11} | 0 83<br>(27 12)<br>{11 33} | 0 17<br>(6 27)<br>{10 48} | 0 15<br>(3 28)<br>{2 93} | 0 30<br>(5 97)<br>{5 88} | -0 13<br>(-4 85)<br>{-4 54} |

Panel B : Past NAV Returns

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | Past Performance NAV return | Reversal |
| International General | 45 53 | 178 | -0 00<br>(-1 26)<br>{-2 02} | 0 00<br>(0 25)<br>{0 14} | -0 01<br>(-0 28)<br>{-0 02} | 0 01<br>(0 35)<br>{0 09} | 0 82<br>(24 88)<br>{10 75} | 0 18<br>(6 53)<br>{11 11} | 0 15<br>(3 37)<br>{3 02} | 0 04<br>(2 42)<br>{2.21} | -0 14<br>(-5 12)<br>{-4 94} |

Panel C : Past Rank

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | Past Performance NAV Rank | Reversal |
| International General | 46 07 | 178 | 0 00<br>(1 19)<br>{1 53} | 0 00<br>(0 06)<br>{-0 05} | -0 00<br>(-0 02)<br>{0 31} | 0 04<br>(1 33)<br>{1 03} | 0 83<br>(25 69)<br>{11 09} | 0 18<br>(6 39)<br>{10 70} | 0 15<br>(3 31)<br>{3 00} | -0 00<br>(-5 51)<br>{-5 71} | -0 13<br>(-5 16)<br>{-4 82} |

## 7.3. Past performance based on managerial performance

The relationship between changes in the discount and past performance has used a measure of performance based on NAV returns. However, in Chapter 5 we discuss the evidence that discounts do not reflect performance when performance is measured using NAV returns. Instead, we introduce a definition of managerial performance that adjusts for the fund's asset exposures - Sharpe's (1992) returns-based style analysis. The results had shown a weak relationship between discounts and past managerial performance when the performance is measured over two- and three- year periods.

Consequently, we use the multi-factor regression model described in section 4.2. to test whether past managerial performance is more significant in explaining the discount's first differences. In Equation (7.4) we substitute the past NAV performance factor, factor six, with a measure of managerial performance. We define excess managerial returns, $R_{Managerial\, j,\, t-1} - R_{Managerial\, i,\, t-1}$, as the difference between the fund managerial performance and the average managerial performance of the category, where we exclude the fund of interest. Past managerial performance is measured over one-month periods.

The returns-based style analysis methodology calculates the monthly values of managerial performance starting from February 1987. The regressions are, therefore, estimated over the period February 1987 to December 1996. Table 7.9 shows the results of the multi-factor regressions. Panel A uses excess managerial returns whereas Panel B is based on excess NAV returns. The estimated coefficient for both measures of past performance, excess managerial returns and NAV returns, is positive and significant. Based on the value of the t-statistics, we reject both null hypotheses that the average coefficient is equal to zero and that the average t-statistic is equal to zero. Nevertheless, the value of the t-statistics and the average adjusted R-squared are higher when the multi-factor regression is estimated using NAV returns rather than managerial returns[157].

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[157] The results are consistent across all categories of funds. The results for categories other than the International General are available from the author.

Table 7.9. Multi-Factor Regression Using Past Performance Measures based on Managerial Performance and NAV Returns - International General category (INGN).

The multi-factor regression described in Equation (7.4) measures the sensitivity of the first differences in the discount to the market, size, sentiment, mean-reversion, past performance, manager and reversal factors. Panel A shows the results using as a measure of past performance the difference between managerial performance of fund j and the average managerial performance of the category, where we exclude the fund of interest. We refer to this measure as excess managerial performance. Monthly managerial performance is defined using Sharpe's (1992) returns-based style analysis. Panel B shows the results using excess NAV returns as a measure of past performance. The regression is estimated over the period February 1987 to December 1996 for all 17 funds in the International General category. The number of observations is the average number of monthly data available for the funds in the International General category. The coefficient is the equally-weighted average of the estimated coefficient from the 17 regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error).

Panel A: Past Managerial Performance

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | Managerial Performance | Reversal |
| International General | 42.25 | 115 | 0.00<br>(-0.92)<br>{-1.33} | 0.00<br>(0.77)<br>{0.62} | 0.00<br>(0.04)<br>{0.56} | 0.03<br>(1.08)<br>{0.76} | 0.80<br>(16.55)<br>{11.16} | 0.17<br>(6.67)<br>{9.46} | 0.13<br>(2.68)<br>{2.05} | 0.21<br>(3.40)<br>{3.39} | -0.17<br>(-5.27)<br>{-5.19} |

Panel B: Past NAV Performance

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| International General | 43.24 | 115 | 0.00<br>(-0.96)<br>{-1.36} | 0.00<br>(0.63)<br>{0.51} | 0.00<br>(0.09)<br>{0.61} | 0.03<br>(1.14)<br>{0.77} | 0.81<br>(16.62)<br>{11.69} | 0.17<br>(6.52)<br>{9.38} | 0.13<br>(2.62)<br>{1.97} | 0.29<br>(4.81)<br>{4.30} | -0.16<br>(-4.80)<br>{-4.73} |

## 7.4. Seasonality in the behaviour of the discount

The multi-factor regression methodology shows that changes in the discount are sensitive to the sentiment, mean-reversion, manager, past performance, and reversal factors. This section extends the analysis to investigate whether these results are related to some seasonality in the behaviour of the discount.

Several hypotheses have been suggested to explain the January seasonal effect in stock returns. The most popular is the year-end tax-loss selling hypothesis (see Keim (1988)) - investors sell securities that have experienced recent price decline in order to offset short-term capital loss against a taxable income. After the tax year-end the selling pressure disappears and the prices rebound. Keim (1983) shows that daily abnormal returns in January are greater than in non-January months and that the negative relation between abnormal returns and size is particularly pronounced in January. It is therefore important to evaluate the extent to which the "January effect" is responsible for the results of the previous sections.

We isolate the January effect by estimating the multi-factor regression described in Equation (7.6). We introduce a dummy variable, *Dummy2,* which is equal to one for the month of January and zero for the other months.

$$\begin{aligned}\Delta d_{j,t} = d_{j,t} - d_{j,t-1} = {} & Dummy1_{j,k} + Dummy2_{k} + \beta_0 \\ & + \beta_1 (R_{UK,t} - R_{F,t}) + \beta_2 (R_{S,t} - R_{L,t}) + \beta_3 (D_{i,t} - D_{i,t-1}) \\ & + \beta_4 (D_{i,t-1} - d_{j,t-1}) + \beta_5 (D_{Mh,t} - D_{Mh,t-1}) \\ & + \beta_6 (R_{NAVj,t-1} - R_{NAVi,t-1}) + \beta_7 (d_{j,t-1} - d_{j,t-2}) + \varepsilon_{j,t}\end{aligned} \tag{7.6}$$

where $Dummy1_{j,k} = \begin{cases} 1 & \text{for } k = 1 \text{ to } 6 \text{ months after the IPO} \\ 0 & \text{elsewhere} \end{cases}$

and $Dummy2_{k} = \begin{cases} 1 & \text{for } k = \text{January month} \\ 0 & \text{elsewhere} \end{cases}$

Table 7.10 shows the results for the ten categories. For six categories - International Capital Growth, UK General, UK Income Growth, Smaller Companies, Japan and Continental Europe - the introduction of the dummy variable, *Dummy2*, increases the adjusted R-squared. However, overall, the estimated coefficients are affected only marginally and the relationship between the changes in the discount and the factors is not modified. The significance of the sentiment, mean-reversion, manager, past performance and reversal factors is not a January effect. Consistent with Section 7 of Chapter 6, we find no evidence of seasonality in the behaviour of the discount. The result is not surprising, given that the discount is an arbitrage portfolio and that a January effect in returns ought not to show up in a long-short portfolio.

Table 7.10. Multi-Factor Regression Based on Non-January Months - All Categories.

The multi-factor regression described in Equation (7.6) measures the sensitivity of the first differences in the discount to the market, size, sentiment, mean-reversion, manager, past performance and reversal factor. The multi-factor regression is estimated introducing a dummy variable, *Dummy2*, which is equal to one for the month of January and zero elsewhere. The regression is estimated over the period February 1981 to December 1996. The sample covers ten AITC categories. We have excluded the UK Capital Growth, High Income, Closed-End Funds and Far East excluding Japan categories given the short history of data for most of the funds in these categories. The number of observations is the average number of monthly data available for the funds in each category. For each of the ten AITC categories, we define the coefficients as the equally-weighted average of the estimated coefficients from the regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error).

| | | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy 1 | Dummy 2 | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| International General | 46 58 | 169 | (-0 00)<br>(-1 01)<br>{-1 50} | 0 02<br>(1 45)<br>{1 30} | (-0 00)<br>(-0 77)<br>{0 01} | 0 01<br>(0 26)<br>{0 59} | 0 05<br>(1 47)<br>{1 18} | 0 83<br>(18 82)<br>{11 09} | 0 18<br>(6 18)<br>{9 49} | 0 14<br>(3 21)<br>{2 70} | 0 29<br>(5 40)<br>{5 12} | -0 13<br>(-5 19)<br>{-4 76} |
| International Capital Growth | 41 92 | 130 | (-0 00)<br>(-0 53)<br>{-1 47} | 0 00<br>(0 37)<br>{0 60} | 0 00<br>(0 45)<br>{0 76} | 0 01<br>(0 29)<br>{0.37} | 0 04<br>(0 90)<br>{1 20} | 0 90<br>(11 36)<br>{9 04} | 0 23<br>(8 77)<br>{12 61} | 0 17<br>(1 58)<br>{3 75} | 0 13<br>(2.33)<br>{4 15} | -0 07<br>(-2.25)<br>{-2 86} |
| International Income Growth | 43 73 | 180 | 0 00<br>(1 03)<br>{1 12} | 0 04<br>(3 39)<br>{3 18} | (-0 00)<br>(-0 28)<br>{-0 45} | 0 05<br>(1 05)<br>{1 14} | 0 05<br>(2 66)<br>{2 79} | 0 58<br>(5 72)<br>{5 60} | 0 09<br>(8 24)<br>{14 44} | 0 17<br>(4 58)<br>{6 39} | 0 38<br>(5 30)<br>{7 63} | -0 18<br>(-3 17)<br>{-3 38} |
| UK General | 28 22 | 128 | (-0 00)<br>(-0 12)<br>{0 02} | 0 01<br>(0 64)<br>{1 03} | -0 01<br>(-1 91)<br>{-1 31} | -0 08<br>(-1 32)<br>{-0 94} | 0 06<br>(1 22)<br>{2 33} | 0 53<br>(4 69)<br>{5 26} | 0 15<br>(5 95)<br>{11 68} | 0 25<br>(3 00)<br>{2 87} | 0 17<br>(3 76)<br>{4.16} | -0 08<br>(-2 37)<br>{-2 09} |
| UK Income Growth | 32.71 | 132 | 0 00<br>(-0 35)<br>{-0 41} | 0 01<br>(0 90)<br>{0 86} | 0 00<br>(0 67)<br>{-0 18} | -0 04<br>(-1 28)<br>{-0 28} | 0 03<br>(0 61)<br>{0 59} | 0 69<br>(12 58)<br>{6 06} | 0 17<br>(7 49)<br>{9 06} | 0 14<br>(3 46)<br>{3 01} | 0 21<br>(2 20)<br>{3 06} | -0 11<br>(-2 92)<br>{-3 52} |
| Smaller Companies | 27 58 | 101 | (-0 00)<br>(-0 70)<br>{-0 86} | 0 02<br>(2 85)<br>{3 19} | 0 00<br>(1 01)<br>{0 62} | 0 01<br>(0 32)<br>{0 30} | 0 01<br>(0 22)<br>{0 56} | 0 74<br>(13 36)<br>{12.09} | 0 19<br>(7 35)<br>{13 85} | 0 18<br>(2 99)<br>{3.95} | 0 17<br>(2 84)<br>{3 86} | -0 10<br>(-4.25)<br>{-4.11} |
| North America | 38 57 | 110 | -0 01<br>(-0 91)<br>{-0 42} | 0 01<br>(0 38)<br>{0 73} | 0 00<br>(0 25)<br>{-0 15} | 0 06<br>(0 86)<br>{1 28} | 0 13<br>(0 95)<br>{0 17} | 0 70<br>(7 32)<br>{4 84} | 0 28<br>(2 82)<br>{19 94} | -0 02<br>(-0 11)<br>{2 34} | 0 25<br>(2 30)<br>{2 49} | -0 05<br>(-1 16)<br>{-2 10} |
| Far East including Japan | 43 02 | 146 | 0 01<br>(0 82)<br>{-0 07} | 0 01<br>(0 61)<br>{0 61} | 0 01<br>(1 64)<br>{1 54} | 0 20<br>(1 92)<br>{3 14} | 0 01<br>(0 13)<br>{0 72} | 0 74<br>(10 21)<br>{5 18} | 0 34<br>(2 78)<br>{13.54} | 0 23<br>(2 60)<br>{2 16} | 0 11<br>(1 86)<br>{3 34} | -0 01<br>(-0 11)<br>{-1 88} |
| Japan | 55 70 | 83 | 0 00<br>(0 18)<br>{0 02} | 0 02<br>(2 13)<br>{3 17} | 0 00<br>(-0 16)<br>{-0 69} | -0 03<br>(-0 57)<br>{0 44} | -0 08<br>(-1 25)<br>{-1 34} | 0 83<br>(22 59)<br>{7 56} | 0.42<br>(4 10)<br>{6 41} | 0 13<br>(1 25)<br>{2 24} | 0 24<br>(4 82)<br>{4 63} | -0 09<br>(-2 12)<br>{-2 54} |
| Continental Europe | 38 75 | 106 | 0 00<br>(-0 72)<br>{-0 55} | 0 02<br>(1 40)<br>{1 57} | 0 00<br>(-0 79)<br>{-0 37} | 0 02<br>(0 48)<br>{0 88} | 0 05<br>(1 54)<br>{1 70} | 0 74<br>(9 61)<br>{7 68} | 0 24<br>(9 98)<br>{12 68} | 0 09<br>(1 74)<br>{2 00} | 0 19<br>(2 45)<br>{4 05} | -0 09<br>(-3 44)<br>{-3 64} |

Nevertheless, there may be some seasonality in the risk. For each month, we measure the standard deviation of the residuals, $\varepsilon_{j,t}$, from the multi-factor regression described in Equation (7.6). Table 7.11 shows the average result for all categories[158]. For five categories, International General, International Income Growth, UK General, UK Income Growth and Smaller Companies, the average standard deviation of the residuals for the month of January is significantly larger than the corresponding value for the non January months. Columns [A] and [B] show the results. The last row of Table 7.11 reports, for each month, the average standard deviation of the residuals across the entire sample. The results show that the variability of the residuals during the month of January is greater than for other months - the difference is significant at the 1 percent level.

Table 7.11. Standard Deviation of the Residuals from the Multi-Factor Regression.

For each month, we measure the standard deviation of the residuals from the multi-factor regression described in Equation (7.6). The table reports the average variability of the residuals for the different categories. The results are shown as percentage values. Column [A] is the average standard deviation for non-January months. Column [B]-[A] is the difference between the variability of the residuals during the month of January and the average value for the other months. Levels of significance for the test of the differences between the two means are denoted by *** (1% level), ** (5% level) and * (10% level).

| | February | March | April | May | June | July | August | September | October | November | December | Non-Jan [A] | January [B] | [B]-[A] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| International General | 2.22 | 2.44 | 2.31 | 2.31 | 2.29 | 1.94 | 2.33 | 2.65 | 2.51 | 2.17 | 2.47 | 2.33 | 2.64 | 0.31 ** |
| International Capital Growth | 2.68 | 3.19 | 2.30 | 2.68 | 2.75 | 2.62 | 2.48 | 2.79 | 2.71 | 2.51 | 2.88 | 2.69 | 2.64 | -0.05 |
| International Income Growth | 2.19 | 2.60 | 2.38 | 3.05 | 2.75 | 2.06 | 2.31 | 2.05 | 2.48 | 2.10 | 2.34 | 2.39 | 2.85 | 0.46 ** |
| UK General | 2.94 | 3.17 | 3.25 | 3.26 | 3.67 | 3.30 | 3.11 | 3.50 | 3.08 | 3.46 | 2.88 | 3.24 | 3.77 | 0.53 ** |
| UK Income Growth | 2.54 | 2.59 | 2.44 | 2.50 | 2.64 | 2.80 | 2.41 | 2.46 | 2.61 | 2.49 | 2.37 | 2.53 | 2.82 | 0.29 * |
| Smaller Companies | 3.69 | 3.54 | 3.03 | 2.85 | 3.81 | 2.76 | 3.16 | 3.24 | 3.44 | 3.46 | 3.20 | 3.29 | 3.73 | 0.44 ** |
| North America | 3.25 | 2.87 | 2.97 | 2.49 | 4.26 | 3.38 | 3.90 | 2.73 | 4.45 | 3.51 | 4.12 | 3.45 | 3.39 | -0.06 |
| Far East including Japan | 2.80 | 3.45 | 3.58 | 3.24 | 3.01 | 3.61 | 3.50 | 3.31 | 3.93 | 4.16 | 2.87 | 3.41 | 3.30 | -0.10 |
| Japan | 3.10 | 2.81 | 2.86 | 2.70 | 2.58 | 2.84 | 2.77 | 3.03 | 3.45 | 2.98 | 2.50 | 2.88 | 2.90 | 0.02 |
| Continental Europe | 3.48 | 3.42 | 3.43 | 2.94 | 3.32 | 3.21 | 3.57 | 3.43 | 3.14 | 3.79 | 3.25 | 3.36 | 3.25 | -0.11 |
| **Average** | **3.08** | **3.20** | **2.91** | **2.77** | **3.16** | **2.80** | **2.91** | **3.09** | **3.05** | **3.09** | **2.92** | **3.00** | **3.21** | **0.22 ***** |

This study of seasonality reports negative results - there is no indication of seasonality in the level of the discounts. Despite evidence of statistical significance of the residual volatility, the economic magnitude is not significant (it represents only an increase relative to the average of a few percentage points).

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[158] We have excluded the UK Capital Growth, High Income, Closed-End Funds and Far East excluding Japan categories given the short history of data for most of the funds in these categories.

# 8. Conclusion

This chapter investigates at first the importance of Fama-French type factors in explaining returns and discount changes for UK closed-end funds. The results show that the factors explain closed-end fund share price and NAV returns, but not discounts changes. We then introduce additional factors in order to explain at least part of the largely idiosyncratic movements in the discount. We investigate the importance of measures of sentiment, mean-reversion, manager, past performance and price reversal.

The multi-factor regression methodology measures the sensitivity of the changes in the discount to the market, size, sentiment, mean-reversion, manager, past performance and reversal factors. This model of the discount generating process seems to capture a significant fraction of the changes in the discount. The seven factors explain, on average, 35 percent of the changes in the discount. The adjusted R-squared is higher than 40 percent for the International General, International Capital Growth, International Income Growth, North America, Far East including Japan and Japan categories. Changes in the discount are particularly sensitive to the sentiment and mean-reversion factors.

Within the framework of the model, we investigate whether for some management groups the manager factor is more significant. The idea is to identify the groups for which the "management brand" has a stronger effect on the discount of the funds under management. We find that for fifteen management groups - M&G, Edinburgh Fund Managers, Kleinworth Benson, Fleming, Govett, Foreign & Colonial, Ivory&Sime, Glasgow Investment Managers, Murray Johnstone, Henderson Investors, Martin Currie, Morgan Grenfell, Exeter Asset Management, Baillie Gifford and Hill Samuel - the estimated slope is significantly different from zero.

We then analyse the sensitivity of the model to different variables. First, we introduce a factor measuring the exposure to the market where the assets are invested, referred to as the local or 'home' market. Despite the evidence that both the UK market and the home market factors are insignificant, the results tend to suggest that closed-end funds act more like securities of the market where they are traded, the UK market, rather than of the market where their assets are invested. We also investigate different definitions of past performance - past NAV returns, rank and managerial performance - and compare them to our measure of excess NAV returns. We find that the measure of excess NAV returns has the highest power in terms of explaining changes in the discount. Finally, we test whether the results from the multi-factor regressions are related to some seasonality in the behaviour of the discount. We find evidence of abnormal variability of residuals during the month of January. Nevertheless, the results of the regression, estimated introducing a dummy variable for the January months, are not significantly different.

# Appendix:

# The multi-factor regression for the individual funds

Table A1: Multi-Factor Regressions.

The multi-factor regression described in Equation (7.4) measures the sensitivity of the first differences in the discount to the market, size, sentiment, mean-reversion, manager, past performance and reversal factor. The regression is estimated over the period February 1981 to December 1996. The table shows the results for the 202 funds in our sample. The number of observations is the number of monthly data available for the funds. We report the estimated coefficients and, in round brackets, the t-statistics. At the end we report the average for the entire sample. The parameter is the equally-weighted average of the estimated coefficients from the 202 regressions. In parentheses, we show the t-statistic for Ho: mean coefficient = 0 (the t-statistic is computed as the average coefficient divided by its cross-sectional standard error). In braces, we show the t-statistic for Ho: mean t-statistic = 0 (the t-statistic is computed as the average t-statistic divided by its cross-sectional standard error).

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| **International General** | | | | | | | | | | | |
| Alliance Trust | 56.93 | 191 | 0.00 | -0.01 | 0.06 | 0.05 | 0.96 | 0.24 | -0.01 | 0.16 | -0.03 |
| | | | (-2.56) | (-0.36) | (1.83) | (1.02) | (13.30) | (4.40) | (-0.12) | (1.06) | (-0.56) |
| Bankers Inv Trust | 38.31 | 191 | 0.01 | -0.01 | 0.02 | 0.00 | 0.72 | 0.15 | 0.22 | 0.35 | -0.27 |
| | | | (2.65) | (-0.34) | (0.38) | (0.05) | (8.14) | (3.48) | (1.87) | (1.90) | (-4.40) |
| Baring Tribune | 48.89 | 191 | 0.00 | -0.05 | 0.12 | 0.09 | 0.76 | 0.10 | 0.38 | 0.37 | -0.26 |
| | | | (-1.87) | (-2.01) | (3.01) | (1.54) | (8.78) | (2.43) | (2.63) | (2.24) | (-4.42) |
| British Inv Trust | 44.19 | 191 | -0.01 | 0.00 | -0.16 | 0.11 | 0.74 | 0.28 | 0.40 | 0.19 | -0.05 |
| | | | (-3.81) | (-0.06) | (-4.43) | (1.93) | (8.74) | (5.60) | (4.01) | (1.30) | (-0.87) |
| Brunner Inv Tst. | 43.53 | 191 | 0.00 | 0.00 | 0.03 | 0.10 | 0.84 | 0.16 | -0.03 | 0.16 | -0.14 |
| | | | (-1.07) | (-0.13) | (0.92) | (1.74) | (9.43) | (3.38) | (-0.31) | (1.11) | (-2.39) |
| Foreign & Colonial | 62.79 | 191 | 0.00 | 0.00 | 0.03 | -0.02 | 0.93 | 0.08 | 0.20 | 0.12 | -0.33 |
| | | | (0.87) | (-0.21) | (1.11) | (-0.50) | (12.49) | (2.28) | (3.14) | (0.98) | (-7.01) |
| Law Debenture | 25.82 | 191 | 0.01 | -0.04 | -0.14 | 0.31 | 0.48 | 0.05 | 0.18 | 0.28 | -0.08 |
| | | | (2.05) | (-1.27) | (-2.79) | (4.18) | (4.32) | (2.09) | (0.96) | (1.58) | (-1.20) |
| Majedie Invs | 43.02 | 134 | -0.03 | -0.04 | -0.12 | 0.04 | 0.95 | 0.47 | 0.31 | 0.05 | 0.06 |
| | | | (-5.40) | (-2.57) | (-2.58) | (0.60) | (6.60) | (6.21) | (1.57) | (0.29) | (0.74) |
| Mid Wynd Intl | 29.34 | 185 | 0.01 | 0.04 | -0.26 | -0.04 | 0.88 | 0.12 | -0.07 | 0.54 | 0.02 |
| | | | (1.88) | (2.24) | (-4.00) | (-0.40) | (5.73) | (3.06) | (-0.57) | (3.87) | (0.31) |
| Personal Assets | 26.84 | 160 | 0.01 | 0.10 | 0.15 | 0.27 | 0.84 | 0.15 | 0.19 | 0.61 | -0.08 |
| | | | (2.06) | (3.60) | (1.80) | (1.96) | (3.33) | (3.84) | (1.03) | (3.75) | (-1.00) |
| Scottish American | 55.06 | 74 | 0.00 | 0.01 | 0.13 | 0.00 | 0.84 | 0.06 | -0.06 | 0.59 | -0.18 |
| | | | (-1.16) | (0.94) | (2.89) | (-0.09) | (6.05) | (0.93) | (-1.63) | (3.67) | (-2.00) |
| Scottish Eastern | 54.80 | 191 | -0.01 | -0.01 | 0.02 | -0.14 | 0.88 | 0.19 | 0.15 | 0.52 | -0.11 |
| | | | (-2.62) | (-0.30) | (0.65) | (-2.73) | (11.70) | (4.01) | (1.90) | (3.70) | (-1.97) |
| Scottish Mortgage | 66.30 | 191 | 0.00 | 0.01 | 0.05 | 0.02 | 0.99 | 0.30 | 0.11 | 0.28 | -0.17 |
| | | | (-1.84) | (0.44) | (1.53) | (0.33) | (13.79) | (4.69) | (2.05) | (2.56) | (-3.55) |
| Scottish Inv | 45.15 | 191 | 0.00 | 0.00 | -0.01 | -0.06 | 0.89 | 0.09 | -0.10 | 0.15 | -0.14 |
| | | | (-1.37) | (0.16) | (-0.14) | (-1.11) | (10.87) | (2.80) | (-0.75) | (0.95) | (-2.42) |
| Second Alliance | 52.58 | 191 | 0.00 | -0.02 | 0.04 | 0.09 | 0.76 | 0.12 | 0.46 | 0.39 | -0.10 |
| | | | (0.44) | (-0.97) | (1.23) | (1.90) | (11.46) | (3.02) | (4.30) | (2.60) | (-1.89) |
| Witan Inv Co | 53.65 | 191 | -0.01 | 0.03 | 0.06 | -0.12 | 0.82 | 0.19 | 0.02 | -0.05 | -0.15 |
| | | | (-3.93) | (1.54) | (1.83) | (-2.50) | (11.30) | (4.47) | (0.21) | (-0.42) | (-2.93) |

Table A1. Multi-Factor Regressions (Cont'd).

|  |  |  |  |  | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| **International Capital Growth** |  |  |  |  |  |  |  |  |  |  |  |
| Anglo & Overseas | 45.83 | 191 | 0.00 | 0.00 | 0.17 | -0.01 | 0.64 | 0.16 | 0.16 | 0.35 | -0.14 |
|  |  |  | (-2.40) | (0.22) | (4.81) | (-0.25) | (7.93) | (3.68) | (2.82) | (2.86) | (-2.35) |
| Baring Stratton | 44.85 | 119 | -0.01 | 0.00 | 0.17 | 0.36 | 0.44 | 0.30 | 0.23 | 0.18 | -0.17 |
|  |  |  | (-2.92) | (0.13) | (3.41) | (4.63) | (3.09) | (4.29) | (1.59) | (0.87) | (-2.01) |
| British Empire Secs | 12.84 | 191 | 0.01 | -0.02 | 0.13 | -0.05 | 0.58 | 0.17 | 0.06 | 0.05 | 0.00 |
|  |  |  | (2.05) | (-0.37) | (1.61) | (-0.42) | (3.19) | (3.83) | (0.40) | (0.33) | (-0.05) |
| Commercial Union Env | 58.68 | 56 | -0.01 | 0.05 | -0.16 | -0.24 | 2.10 | 0.17 | 0.70 | 0.47 | 0.21 |
|  |  |  | (-1.76) | (1.98) | (-1.05) | (-1.50) | (7.06) | (3.20) | (2.29) | (2.22) | (2.15) |
| Dunedin Worldwide | 46.69 | 191 | 0.00 | -0.02 | 0.03 | 0.07 | 0.76 | 0.11 | 0.33 | 0.12 | -0.18 |
|  |  |  | (-0.93) | (-0.93) | (0.93) | (1.37) | (10.36) | (2.78) | (3.93) | (1.19) | (-3.22) |
| Electric & General | 43.00 | 191 | 0.00 | 0.00 | 0.12 | 0.02 | 0.78 | 0.16 | 0.29 | 0.13 | -0.19 |
|  |  |  | (-0.80) | (-0.09) | (3.00) | (0.27) | (8.74) | (3.57) | (2.43) | (1.08) | (-3.21) |
| English & Scottish | 50.18 | 191 | 0.00 | 0.01 | 0.13 | 0.05 | 0.99 | 0.33 | 0.05 | 0.21 | -0.11 |
|  |  |  | (-0.12) | (0.24) | (3.08) | (0.69) | (10.01) | (5.37) | (0.70) | (1.73) | (-1.94) |
| Finsbury Wwd Pharm | 28.17 | 20 | 0.07 | -0.05 | -0.19 | 0.13 | 1.60 | 0.32 | 1.30 | -0.33 | 0.05 |
|  |  |  | (1.63) | (-1.49) | (-0.24) | (0.22) | (1.81) | (1.48) | (1.37) | (-0.60) | (0.19) |
| Fleming Overseas | 57.02 | 191 | -0.01 | 0.00 | 0.10 | -0.08 | 0.91 | 0.19 | 0.63 | 0.40 | -0.16 |
|  |  |  | (-2.46) | (0.01) | (2.53) | (-1.20) | (10.33) | (3.87) | (6.00) | (3.61) | (-2.80) |
| Govett Global Smcos | 37.78 | 32 | -0.02 | 0.01 | 0.19 | 0.12 | 0.96 | 0.35 | 0.22 | 0.14 | 0.07 |
|  |  |  | (-2.21) | (0.49) | (0.82) | (0.53) | (2.36) | (2.28) | (0.80) | (0.46) | (0.33) |
| Greenfriar | 43.19 | 191 | 0.00 | 0.01 | -0.37 | 0.07 | 1.14 | 0.19 | 0.31 | 0.15 | 0.14 |
|  |  |  | (1.56) | (0.24) | (-6.43) | (0.82) | (8.99) | (4.49) | (1.86) | (1.23) | (2.24) |
| Jup Intl Grn | 7.47 | 47 | 0.01 | -0.01 | -0.06 | -0.40 | 0.75 | 0.29 | 0.14 | -0.19 | 0.03 |
|  |  |  | (1.88) | (-0.46) | (-0.33) | (-1.82) | (1.92) | (2.65) | (0.76) | (-0.54) | (0.22) |
| Kleinwort Overseas | 37.81 | 191 | 0.00 | -0.01 | 0.13 | 0.01 | 0.70 | 0.25 | 0.30 | 0.21 | -0.04 |
|  |  |  | (-2.06) | (-0.40) | (3.25) | (0.23) | (7.70) | (4.73) | (3.15) | (1.41) | (-0.70) |
| Monks Inv Trust | 49.65 | 191 | 0.00 | 0.00 | 0.02 | -0.03 | 0.85 | 0.10 | 0.22 | 0.25 | -0.17 |
|  |  |  | (-0.44) | (-0.19) | (0.46) | (-0.52) | (10.91) | (2.70) | (3.96) | (2.42) | (-3.04) |
| Murray Smaller Mkts | 50.46 | 191 | 0.00 | 0.05 | 0.05 | -0.02 | 1.14 | 0.11 | 0.16 | 0.24 | -0.10 |
|  |  |  | (1.64) | (1.64) | (1.06) | (-0.32) | (10.91) | (2.80) | (2.35) | (2.72) | (-1.82) |
| Overseas Inv | 36.30 | 191 | 0.00 | 0.00 | 0.00 | 0.07 | 0.81 | 0.10 | 0.18 | 0.42 | -0.12 |
|  |  |  | (0.29) | (0.09) | (-0.04) | (0.96) | (7.96) | (2.59) | (2.21) | (4.35) | (-1.86) |
| Primadona | 27.59 | 78 | -0.02 | 0.05 | -0.08 | 0.07 | 1.13 | 0.25 | -0.04 | 0.57 | 0.19 |
|  |  |  | (-2.60) | (1.08) | (-0.62) | (0.46) | (3.58) | (3.03) | (-0.52) | (2.45) | (1.52) |
| Ptarmigan Intl | 34.21 | 79 | -0.01 | 0.01 | 0.03 | -0.06 | 0.80 | 0.52 | -0.21 | 0.13 | -0.09 |
|  |  |  | (-1.61) | (0.29) | (0.26) | (-0.41) | (2.74) | (3.85) | (-0.92) | (0.61) | (-0.90) |
| Rit Capital Partners | 32.76 | 101 | -0.01 | -0.01 | 0.52 | 0.17 | 0.40 | 0.09 | -0.22 | 0.15 | -0.09 |
|  |  |  | (-1.79) | (-0.29) | (5.18) | (1.35) | (1.63) | (1.97) | (-0.63) | (1.01) | (-0.95) |
| Tr Technology | 24.49 | 51 | 0.01 | -0.01 | -0.07 | -0.05 | 1.11 | 0.21 | 0.00 | 0.03 | -0.20 |
|  |  |  | (1.41) | (-0.87) | (-0.39) | (-0.30) | (3.74) | (1.76) | (0.01) | (0.13) | (-1.44) |
| Updown Inv | 58.00 | 191 | 0.01 | -0.06 | -0.56 | 0.00 | 0.20 | 0.20 | 0.01 | -0.10 | -0.17 |
|  |  |  | (3.71) | (-2.26) | (-12.04) | (0.06) | (1.99) | (6.37) | (0.17) | (-1.01) | (-3.29) |
| **International Income Growth** |  |  |  |  |  |  |  |  |  |  |  |
| British Assets | 37.35 | 191 | 0.00 | -0.03 | 0.17 | 0.07 | 0.43 | 0.08 | 0.13 | 0.25 | -0.31 |
|  |  |  | (-0.53) | (-1.08) | (3.83) | (1.06) | (5.62) | (2.40) | (1.73) | (2.11) | (-5.06) |
| Murray Intl | 58.64 | 191 | 0.00 | 0.02 | 0.03 | -0.01 | 0.86 | 0.07 | 0.09 | 0.42 | -0.17 |
|  |  |  | (0.96) | (0.73) | (0.74) | (-0.20) | (12.50) | (2.35) | (1.77) | (3.04) | (-3.40) |
| Securities Tst Sctl | 37.68 | 191 | 0.00 | -0.02 | 0.09 | 0.03 | 0.48 | 0.12 | 0.24 | 0.26 | -0.05 |
|  |  |  | (1.77) | (-1.11) | (2.49) | (0.49) | (7.59) | (3.37) | (2.88) | (2.00) | (-0.73) |
| **UK General** |  |  |  |  |  |  |  |  |  |  |  |
| Albany Inv Trust | 28.92 | 191 | 0.00 | -0.08 | -0.24 | 0.32 | 0.39 | 0.14 | 0.18 | 0.04 | -0.10 |
|  |  |  | (0.34) | (-2.03) | (-3.55) | (2.96) | (2.47) | (3.52) | (1.52) | (0.18) | (-1.31) |
| Edinburgh Inv Trust | 33.30 | 191 | 0.00 | 0.02 | 0.14 | 0.05 | 0.04 | 0.05 | 0.46 | 0.11 | -0.30 |
|  |  |  | (-0.95) | (0.65) | (3.63) | (0.80) | (0.44) | (2.54) | (5.19) | (1.01) | (-4.91) |

Table A1. Multi-Factor Regressions (Cont'd).

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| **UK General (Cont'd)** | | | | | | | | | | | |
| F&C Pep Inv Tst | 28 62 | 50 | 0 04 | -0 01 | -0 07 | 0 15 | 0 77 | 0 36 | 0 10 | -0 08 | -0 17 |
| | | | (2 64) | (-0 90) | (-0 49) | (1 25) | (2 93) | (2 65) | (0 45) | (-0 24) | (-1 26) |
| F&C Spc Utils Pkg.Uts | 40 25 | 41 | -0 01 | 0 04 | 0 33 | 0 03 | 0 54 | 0 16 | 1 24 | 0 12 | -0 13 |
| | | | (-1 69) | (1 78) | (1 52) | (0 13) | (1 11) | (2 03) | (2 79) | (0 50) | (-0 71) |
| Finsbury Growth Tst | 32 49 | 183 | 0 00 | -0 02 | -0 23 | 0 13 | 0 59 | 0 16 | 0 00 | 0 19 | 0 07 |
| | | | (-0 75) | (-0 51) | (-4 17) | (1 42) | (4 30) | (3 89) | (0 05) | (1 81) | (0 93) |
| Finsbury Trust | 25 91 | 188 | 0 00 | 0 00 | -0 10 | 0 18 | 0 88 | 0 04 | -0 06 | 0 26 | 0 11 |
| | | | (0 73) | (-0 20) | (-1 48) | (1 78) | (5 63) | (1 73) | (-0 64) | (2 42) | (1 73) |
| Fleming Claverhouse | 29 62 | 191 | 0 00 | 0 03 | 0 01 | 0 11 | 0 32 | 0 04 | 0 39 | 0 25 | -0 28 |
| | | | (0 87) | (0 94) | (0 11) | (1 51) | (3 21) | (1 32) | (4 04) | (2 66) | (-4 28) |
| Frnds Prvt.Pkg.Ethi | 19 23 | 36 | 0 01 | 0 02 | 0 08 | -0 37 | 1 50 | 0 24 | 0 28 | 0 10 | 0 14 |
| | | | (1 59) | (1 47) | (0 40) | (-1 66) | (2 75) | (1 95) | (0 63) | (0 34) | (0 75) |
| Gart.Scotland | 48 76 | 64 | 0 00 | 0 05 | -0 38 | -0.35 | 1 20 | 0 12 | 0 18 | 0 40 | -0 26 |
| | | | (0 32) | (3 27) | (-3 88) | (-2.86) | (4 86) | (3 25) | (0 98) | (1 33) | (-2 54) |
| Govett Strategic | 24 38 | 191 | -0 01 | 0 03 | 0 11 | -0 03 | 0 50 | 0 25 | 0 07 | 0 30 | -0 07 |
| | | | (-3 09) | (1 01) | (2 00) | (-0 31) | (4 00) | (4 06) | (1 18) | (3 48) | (-0 88) |
| Inv Tst Guernsey | 10 39 | 179 | 0 00 | -0 01 | -0 18 | 0 05 | 0 15 | 0 17 | 0 16 | -0 09 | -0 05 |
| | | | (-0 83) | (-0 26) | (-1 87) | (0.33) | (0 73) | (3 96) | (0 59) | (-0 59) | (-0 65) |
| Malvern Uk Index Tst | 14 48 | 76 | 0 01 | -0 02 | 0 09 | 0 08 | 0 06 | 0 12 | -0 04 | 0 29 | -0 19 |
| | | | (2 08) | (-1 36) | (1 50) | (1 14) | (0 52) | (2 29) | (-0 31) | (2 09) | (-1 66) |
| Mercury Keystone | 16 48 | 191 | 0 00 | 0 00 | 0 12 | 0 23 | 0 30 | 0 09 | 0 06 | 0 29 | -0 13 |
| | | | (0 70) | (0 02) | (2 39) | (3 16) | (2 71) | (2 45) | (0 42) | (2 40) | (-1 88) |
| Welsh Industrial It. | 15 82 | 91 | -0 07 | -0 03 | -0 58 | -0 39 | -0 04 | 0 38 | 0 62 | -0 18 | 0 03 |
| | | | (-3 43) | (-0 52) | (-2 00) | (-1 03) | (-0 06) | (4 27) | (1 21) | (-0 78) | (0 29) |
| **UK Capital Growth** | | | | | | | | | | | |
| Asset Management Inv Co | 8 69 | 25 | -0 01 | 0 06 | -0 06 | 0 17 | 1 36 | 0 11 | 0 35 | 0 16 | -0 09 |
| | | | (-1 17) | (2 20) | (-0 12) | (0 34) | (2 06) | (0 90) | (0 48) | (0 35) | (-0 34) |
| Broadgate It. | 47 55 | 52 | 0 00 | 0 01 | -0 41 | 0 78 | -0 37 | 0 10 | 0 24 | 0 21 | -0 05 |
| | | | (-0 82) | (0 45) | (-1 89) | (3 55) | (-1 27) | (1 07) | (0 72) | (0 77) | (-0 32) |
| Fidelity Spc Values | 37 46 | 25 | -0 03 | 0 01 | 0 60 | -0 44 | 0 74 | 0 78 | 0 02 | 0 15 | 0 19 |
| | | | (-3 31) | (0 57) | (1 75) | (-1 18) | (1 45) | (3 22) | (0 10) | (0 42) | (0 77) |
| I&S Ins Trust | 29 92 | 42 | -0 02 | 0 02 | -0 45 | 0 29 | 0 69 | 0 11 | 0 25 | 0 21 | 0 05 |
| | | | (-1 66) | (1 31) | (-2 36) | (1 24) | (1 96) | (1 55) | (0 68) | (0 70) | (0 32) |
| Kleinwort Endowment | 24 42 | 52 | 0 01 | 0 01 | 0 20 | 0 35 | -0 10 | 0 18 | 1 03 | 0 21 | 0 20 |
| | | | (1 21) | (0 57) | (1 16) | (1 90) | (-0 50) | (2 18) | (2 90) | (1 30) | (1 45) |
| Klein 2Nd Endowment | 16 14 | 36 | 0 00 | 0 00 | 0 34 | -0 14 | 0 99 | 0 10 | 0 90 | 0 20 | 0 01 |
| | | | (0 47) | (-0 15) | (1 14) | (-0 42) | (1 77) | (0 98) | (1 19) | (0 78) | (0 03) |
| L&G Recovery | 50 67 | 24 | -0 05 | 0 00 | 0 67 | 0 32 | 0 04 | 0 33 | 0 62 | 0 33 | -0 22 |
| | | | (-3 84) | (0 03) | (2 63) | (1 34) | (0 11) | (2 97) | (1 45) | (0 75) | (-1 05) |
| M&G Recovery | 50 09 | 56 | 0 00 | 0 10 | 0 16 | 0.31 | -0 21 | 0 15 | 0 82 | 0 17 | -0.22 |
| | | | (0 06) | (3 42) | (0 99) | (1 78) | (-1 24) | (2 60) | (5 32) | (0 77) | (-1 96) |
| Schroder Uk Growth | 18 56 | 33 | 0 05 | -0 01 | 0 01 | 0 14 | 0 64 | 0 91 | 0 10 | -0 33 | -0 08 |
| | | | (2 07) | (-0.61) | (0 05) | (0 44) | (1 23) | (2 30) | (0 83) | (-0 73) | (-0.30) |
| Undervalued Assets | 38 82 | 32 | 0 01 | 0 00 | 0 29 | 0 12 | 0 62 | 0 42 | 0 19 | 0 12 | -0 26 |
| | | | (1 55) | (0 35) | (1 87) | (0 60) | (2 37) | (1 98) | (1 01) | (0 49) | (-1 50) |
| **UK Income Growth** | | | | | | | | | | | |
| Dunedin Inc.Growth | 41 81 | 191 | 0 00 | 0 00 | -0 02 | 0 07 | 0 74 | 0 17 | 0 19 | 0 49 | -0 16 |
| | | | (-1 23) | (-0 04) | (-0 54) | (1 06) | (8 30) | (3 42) | (2 03) | (3 54) | (-2 64) |
| Flem Inc&Cap | 9 38 | 57 | 0 00 | -0 01 | 0 06 | 0 22 | 0 91 | 0 19 | -0 06 | 0 27 | -0 03 |
| | | | (0 11) | (-0 77) | (0 46) | (1 42) | (2 59) | (2 02) | (-0 17) | (0 58) | (-0 21) |
| Gart.Bnt.I&G | 16 45 | 33 | 0 01 | -0 02 | -0 33 | 0 18 | 0 51 | 0 02 | 0 31 | -0 26 | 0 19 |
| | | | (1 18) | (-1 40) | (-1.99) | (0 87) | (1 42) | (0 16) | (0 85) | (-0 47) | (0 98) |
| Investors Cap | 33 47 | 191 | 0.00 | -0 01 | 0 03 | 0 05 | 0 72 | 0 10 | 0 05 | 0 44 | -0 19 |
| | | | (-0 43) | (-0 38) | (0 70) | (0 63) | (6 41) | (2 16) | (0 69) | (3 43) | (-2 80) |

Table A1. Multi-Factor Regressions (Cont'd).

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| **UK Income Growth (Cont'd)** | | | | | | | | | | | |
| Lowland Inv | 9 73 | 191 | 0 01 | -0 03 | -0 08 | 0 28 | 0 18 | 0 14 | 0 04 | -0 07 | -0 01 |
| | | | (2 90) | (-0 73) | (-1 18) | (2 62) | (1 31) | (3 66) | (0 22) | (-0 43) | (-0 15) |
| M&G Income Pkg.Units | 56 36 | 51 | 0 00 | 0 04 | -0 18 | -0 25 | 0 90 | 0 33 | 0 36 | -0 26 | 0 18 |
| | | | (1 06) | (1 84) | (-1 67) | (-2.25) | (3 66) | (3 82) | (4 65) | (-0 73) | (1 77) |
| Merchants Trust | 47 78 | 191 | 0 00 | 0 00 | 0 08 | 0 02 | 0 76 | 0 12 | 0 35 | 0 21 | -0 19 |
| | | | (-1 71) | (-0 12) | (2 37) | (0 31) | (9 39) | (3 04) | (3 82) | (1 50) | (-3 25) |
| Morgren.Equity Inc | 26 27 | 60 | -0 01 | 0 02 | -0 18 | 0 02 | 0 60 | 0 31 | 0 16 | 0 35 | -0 22 |
| | | | (-2.32) | (0 90) | (-1 55) | (0 14) | (2 19) | (2 88) | (0 66) | (0 84) | (-1 77) |
| Murray Income | 51 32 | 191 | 0 00 | -0 01 | -0 02 | -0 07 | 0 99 | 0 18 | 0 08 | 0 09 | -0 20 |
| | | | (0 82) | (-0 48) | (-0 54) | (-1 25) | (11 50) | (3 72) | (1 40) | (0 59) | (-3 33) |
| Prolific Income | 18 00 | 26 | 0 00 | -0 02 | -0 05 | -0.14 | 0.59 | 0 18 | 0 29 | 0 96 | -0 03 |
| | | | (-0 13) | (-1 10) | (-0 14) | (-0 52) | (1 19) | (1 47) | (0 52) | (2 05) | (-0 16) |
| Temple Bar | 42 52 | 191 | 0 00 | 0 01 | 0 12 | -0 04 | 0 61 | 0 13 | -0 08 | 0 26 | -0 29 |
| | | | (-1 94) | (0 47) | (3 08) | (-0 73) | (7 54) | (3 58) | (-0 63) | (2 13) | (-5 11) |
| Tr City Of London | 36 45 | 191 | 0 00 | 0 03 | 0 06 | -0 07 | 0 72 | 0 14 | 0 00 | 0 23 | -0 23 |
| | | | (0 52) | (1 09) | (1 59) | (-1 16) | (8 17) | (3 35) | (0 04) | (1 70) | (-3 77) |
| Value & Income | 13 81 | 184 | 0 00 | -0 01 | 0 08 | 0 21 | 0 44 | 0 13 | 0 10 | 0 11 | -0 10 |
| | | | (-0 40) | (-0 39) | (1 25) | (1 88) | (2 78) | (3 77) | (0 72) | (1 29) | (-1 34) |
| **High Income** | | | | | | | | | | | |
| Abtrust Convertible It | 35 29 | 41 | 0 00 | 0 04 | 0 00 | -0 81 | 1 03 | 0 34 | 1 02 | 0 36 | -0 04 |
| | | | (0 13) | (1 46) | (-0 01) | (-2 40) | (1 86) | (2 35) | (1 99) | (0 94) | (-0 24) |
| Abtrust High Income | 23 11 | 33 | -0 02 | -0 01 | -0 03 | 0 20 | 0 33 | 0 45 | 0 14 | 0 67 | -0 08 |
| | | | (-1 73) | (-0 69) | (-0 12) | (0 83) | (0 86) | (2 53) | (0 44) | (2 21) | (-0 44) |
| Bzw Convertible | 25 64 | 81 | 0 02 | -0 03 | 0 18 | -0 46 | 0 77 | 0 34 | 0 73 | 0 06 | -0 10 |
| | | | (2 39) | (-1 20) | (1 21) | (-2 13) | (2 99) | (3 27) | (1 60) | (0 23) | (-0 86) |
| City Mrch High Yld | 13 72 | 66 | -0 01 | 0 00 | 0 05 | -0 14 | 0 55 | 0 17 | 0 08 | -0 14 | -0 11 |
| | | | (-1 44) | (0 18) | (0 51) | (-1 16) | (3 16) | (2 11) | (1 08) | (-0 87) | (-0 83) |
| Dartmoor Inv Tst | 29 87 | 79 | 0 04 | -0 07 | -0 71 | -0 40 | 0 21 | 0 25 | 0 21 | -0 14 | -0 13 |
| | | | (3 35) | (-2 36) | (-4 31) | (-2.07) | (0 79) | (3 39) | (1.53) | (-0 88) | (-1.13) |
| Geared Income Trust | 30 77 | 68 | 0 02 | 0 00 | -0 10 | 0 13 | 0 21 | 0 61 | -0 79 | -0 25 | -0 03 |
| | | | (3 22) | (0 12) | (-0 77) | (0 70) | (1 01) | (4 80) | (-2 14) | (-1 24) | (-0 22) |
| Glasgow Income | 34 26 | 100 | -0 01 | 0 07 | -0 29 | 0 17 | 0 46 | 0 20 | 0 16 | -0 23 | -0 10 |
| | | | (-1 53) | (3 13) | (-3 30) | (1 52) | (3 18) | (3 81) | (1 43) | (-1 32) | (-1 08) |
| Govett High Income | 18 59 | 36 | -0 04 | 0 02 | -0 11 | -0 20 | 0 94 | 0 53 | 0 13 | -0 50 | 0 19 |
| | | | (-2 81) | (0 66) | (-0 50) | (-0 76) | (2 50) | (2 85) | (0 46) | (-1 15) | (0 94) |
| Henderson Highland | 27 69 | 81 | -0 02 | 0 06 | -0 01 | 0 16 | 0 41 | 0 29 | 0 19 | 0 30 | -0 13 |
| | | | (-3 17) | (2 50) | (-0 05) | (1 30) | (2 36) | (3 34) | (0 64) | (1 19) | (-1 07) |
| Shires Income Tst. | 35 18 | 95 | -0 01 | 0 00 | 0 14 | 0 23 | 0 66 | 0 23 | 0 22 | -0 14 | -0 33 |
| | | | (-2 27) | (-0 09) | (1 38) | (1 81) | (4 24) | (3 04) | (1 73) | (-0 60) | (-3 30) |
| Tr High Income | 23 63 | 84 | -0 01 | 0 04 | -0 10 | 0 20 | 0 45 | 0 12 | 0 34 | 0 15 | -0 15 |
| | | | (-1.65) | (2 01) | (-0 92) | (1 56) | (2 96) | (2 26) | (1 28) | (0 69) | (-1 37) |
| **Closed-End Funds** | | | | | | | | | | | |
| Capital Gearing Tst. | 4 61 | 191 | 0 00 | -0 08 | 0 17 | 0 32 | 0 15 | 0 03 | 0 30 | -0 14 | 0 07 |
| | | | (0 66) | (-1 10) | (1 49) | (1 64) | (1 19) | (1 29) | (1 36) | (-0 98) | (0 96) |
| Exeter Preferred Cap | 26 49 | 58 | -0 02 | 0 08 | -0 15 | -0 28 | 0 55 | 0 14 | 0 24 | -0 04 | -0 10 |
| | | | (-3 02) | (4 02) | (-1 00) | (-1 70) | (1.52) | (2 65) | (1 95) | (-0 25) | (-0 78) |
| London & St Lawrence | 3 66 | 191 | 0 00 | -0 03 | -0 03 | -0 04 | 0 04 | 0 01 | 0 16 | 0 09 | -0 18 |
| | | | (-0 13) | (-0 57) | (-0 48) | (-0 34) | (0.91) | (0 99) | (1.17) | (1 01) | (-2.41) |
| New City & Coml | 23 51 | 47 | -0 02 | -0.01 | -0 19 | 0 00 | 0 22 | 0 34 | -0 69 | -0 01 | -0 19 |
| | | | (-2.39) | (-0 54) | (-0 96) | (-0 02) | (0 46) | (2 54) | (-1.95) | (-0 07) | (-1 14) |
| Scottish Value | 4 84 | 42 | 0 01 | 0 02 | 0 16 | 0 20 | -0 24 | 0 13 | -0.14 | -0 07 | -0 10 |
| | | | (0 85) | (1 02) | (1.36) | (1 32) | (-0 89) | (1 14) | (-1 09) | (-0.31) | (-0.49) |
| World Trust Fund | 25 86 | 64 | -0 01 | 0 00 | 0 00 | -0 02 | -0 08 | 0 43 | -0 46 | 0 10 | -0 01 |
| | | | (-1 87) | (0 12) | (-0 03) | (-0 13) | (-0 53) | (4 06) | (-1 49) | (0 55) | (-0 04) |

Table A1. Multi-Factor Regressions (Cont'd).

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| **Smaller Companies** | | | | | | | | | | | |
| 3I Sm Quoted Cos Trust | 23.91 | 191 | 0.00 | -0.04 | -0.09 | -0.13 | 0.60 | 0.11 | 0.02 | 0.41 | -0.21 |
| | | | (-0.15) | (-1.03) | (-1.57) | (-1.53) | (4.12) | (2.67) | (0.11) | (2.96) | (-3.14) |
| Aberforth Smcos | 9.60 | 71 | 0.00 | 0.02 | -0.08 | -0.16 | 0.31 | 0.08 | 0.11 | 0.45 | -0.15 |
| | | | (0.30) | (1.05) | (-0.71) | (-1.16) | (1.43) | (1.50) | (0.31) | (2.16) | (-1.27) |
| Aberforth Spl | 34.29 | 53 | 0.03 | 0.07 | 0.19 | -0.06 | 0.79 | 0.42 | -0.96 | 0.30 | -0.27 |
| | | | (2.64) | (2.31) | (1.25) | (-0.33) | (2.67) | (3.43) | (-2.25) | (0.76) | (-2.15) |
| Amicable Smaller Ents | 38.41 | 57 | -0.01 | 0.04 | -0.09 | 0.15 | 1.17 | 0.56 | 0.65 | -0.08 | -0.01 |
| | | | (-1.14) | (1.28) | (-0.58) | (0.72) | (3.46) | (3.84) | (1.39) | (-0.23) | (-0.10) |
| Beacon Inv Trust | 14.48 | 29 | -0.03 | 0.02 | 0.36 | -0.02 | 0.38 | 0.32 | 0.04 | -0.52 | -0.38 |
| | | | (-2.01) | (0.49) | (1.05) | (-0.06) | (0.49) | (1.65) | (0.13) | (-1.48) | (-1.65) |
| Dunedin Smaller Cos | 21.23 | 191 | 0.00 | 0.02 | -0.03 | 0.02 | 0.60 | 0.07 | 0.22 | 0.47 | -0.07 |
| | | | (1.11) | (0.92) | (-0.73) | (0.25) | (5.16) | (2.01) | (2.22) | (3.06) | (-1.03) |
| Eaglet Inv Tst | 28.33 | 41 | -0.01 | 0.03 | -0.16 | 0.03 | 1.21 | 0.14 | 0.13 | -0.07 | -0.24 |
| | | | (-1.55) | (1.97) | (-1.02) | (0.18) | (3.73) | (1.93) | (0.66) | (-0.27) | (-1.51) |
| Edinburgh Smcos It | 13.93 | 41 | -0.01 | 0.00 | 0.07 | -0.28 | 0.90 | 0.07 | -0.10 | 0.11 | -0.11 |
| | | | (-1.07) | (-0.04) | (0.41) | (-1.61) | (2.77) | (0.61) | (-0.30) | (0.44) | (-0.62) |
| F&C Smaller Cos | 44.15 | 191 | 0.00 | 0.00 | 0.02 | 0.23 | 0.91 | 0.13 | 0.43 | 0.43 | -0.13 |
| | | | (0.64) | (0.16) | (0.46) | (3.12) | (7.18) | (2.95) | (5.12) | (3.80) | (-2.05) |
| Fleming Fledgeling | 33.62 | 178 | 0.00 | 0.00 | -0.13 | 0.09 | 0.73 | 0.22 | 0.25 | 0.45 | 0.00 |
| | | | (0.13) | (0.06) | (-2.52) | (1.08) | (5.28) | (3.73) | (1.94) | (4.11) | (0.02) |
| Fleming Mercantile | 27.99 | 191 | -0.01 | 0.02 | 0.14 | 0.06 | 0.49 | 0.07 | 0.28 | 0.25 | -0.14 |
| | | | (-1.86) | (0.61) | (3.29) | (0.96) | (4.43) | (2.10) | (2.82) | (2.23) | (-2.10) |
| Fleming Smaller Cos | 28.43 | 76 | 0.00 | 0.00 | 0.32 | 0.05 | 0.85 | 0.09 | 0.42 | -0.10 | -0.28 |
| | | | (-1.17) | (-0.01) | (2.51) | (0.33) | (3.36) | (1.45) | (1.41) | (-0.37) | (-2.33) |
| Framlington 1000 Smcos | 49.86 | 52 | -0.01 | -0.01 | 0.17 | 0.03 | 1.21 | 0.30 | 0.50 | -0.17 | -0.16 |
| | | | (-1.71) | (-0.55) | (1.24) | (0.23) | (5.47) | (2.62) | (1.43) | (-0.84) | (-1.47) |
| Gartmore Micro Index | 24.30 | 24 | 0.00 | 0.00 | -0.46 | -0.43 | 0.67 | 0.23 | -0.79 | -0.59 | -0.37 |
| | | | (0.27) | (0.18) | (-1.17) | (-1.38) | (1.04) | (1.53) | (-1.69) | (-1.40) | (-1.88) |
| Gartmore Smaller Cos | 16.68 | 191 | 0.00 | -0.02 | -0.11 | 0.03 | 0.48 | 0.10 | 0.33 | 0.29 | -0.10 |
| | | | (-0.03) | (-0.57) | (-1.71) | (0.30) | (2.81) | (3.15) | (3.23) | (1.97) | (-1.42) |
| Group Trust | 7.66 | 110 | -0.02 | -0.04 | 0.17 | 0.33 | 0.43 | 0.10 | 0.00 | 0.21 | 0.00 |
| | | | (-1.62) | (-1.05) | (1.23) | (1.50) | (1.23) | (2.02) | (0.01) | (1.13) | (-0.00) |
| Henderson Strata | 19.09 | 133 | 0.00 | 0.02 | 0.04 | 0.22 | 0.81 | 0.09 | 0.46 | 0.17 | 0.07 |
| | | | (0.16) | (1.05) | (0.55) | (2.09) | (4.01) | (2.53) | (2.01) | (0.92) | (0.80) |
| Herald Inv Tst. | 33.50 | 34 | 0.00 | 0.01 | 0.35 | 0.05 | 1.30 | 0.32 | 0.84 | 0.51 | -0.06 |
| | | | (0.36) | (0.48) | (1.13) | (0.13) | (2.46) | (1.60) | (0.99) | (1.54) | (-0.35) |
| Hoare Govett Smcos | 49.64 | 48 | 0.03 | 0.02 | -0.31 | 0.20 | 0.99 | 0.41 | 0.41 | -0.56 | 0.07 |
| | | | (3.31) | (1.20) | (-2.30) | (1.55) | (3.91) | (3.65) | (1.16) | (-2.43) | (0.52) |
| Hoare Govett 1000 Idx. | 19.79 | 25 | 0.01 | 0.04 | 0.15 | -0.12 | 0.75 | 0.30 | 0.31 | -0.12 | -0.15 |
| | | | (0.93) | (2.37) | (0.47) | (-0.46) | (1.48) | (1.49) | (0.73) | (-0.23) | (-0.49) |
| I&S Uk Discovery | 48.25 | 20 | -0.03 | 0.04 | -0.30 | 0.03 | 0.96 | 0.82 | 0.81 | -0.99 | -0.09 |
| | | | (-2.11) | (1.35) | (-0.75) | (0.11) | (1.43) | (2.75) | (1.33) | (-2.49) | (-0.41) |
| I&S Uk Smaller Cos | 14.96 | 188 | 0.01 | 0.10 | 0.15 | 0.13 | 0.99 | 0.13 | 0.20 | 0.07 | -0.11 |
| | | | (1.34) | (3.14) | (1.45) | (0.80) | (3.57) | (3.79) | (1.11) | (0.40) | (-1.43) |
| Invesco Eng & Intl | 21.84 | 191 | 0.00 | 0.02 | -0.09 | -0.16 | 1.10 | 0.10 | -0.07 | 0.84 | 0.07 |
| | | | (-0.78) | (0.43) | (-1.01) | (-1.08) | (4.39) | (3.30) | (-0.80) | (5.25) | (1.01) |
| Invesco Enterprise | 16.36 | 191 | 0.00 | 0.04 | -0.07 | -0.04 | 0.59 | 0.08 | 0.11 | 0.53 | 0.04 |
| | | | (-0.72) | (0.67) | (-0.83) | (-0.26) | (2.49) | (2.49) | (1.24) | (4.57) | (0.60) |
| Kleinwort Smaller Cos | 17.94 | 191 | 0.01 | 0.03 | -0.21 | -0.30 | 0.85 | 0.12 | -0.08 | 0.22 | 0.03 |
| | | | (1.77) | (0.71) | (-3.34) | (-2.96) | (5.00) | (3.36) | (-0.52) | (1.59) | (0.44) |
| Lloyds Smcos Pkg.Units | 32.96 | 57 | 0.00 | 0.05 | -0.18 | -0.03 | 0.80 | 0.23 | 0.03 | 0.11 | -0.05 |
| | | | (0.82) | (2.50) | (-1.64) | (-0.25) | (3.34) | (3.34) | (0.25) | (0.23) | (-0.41) |
| Moorgate Inv | 4.19 | 191 | 0.00 | -0.02 | -0.02 | 0.11 | 0.37 | 0.04 | 0.02 | 0.21 | -0.03 |
| | | | (0.58) | (-0.56) | (-0.28) | (1.28) | (2.40) | (1.67) | (0.17) | (1.29) | (-0.42) |

Table A1. Multi-Factor Regressions (Cont'd).

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| **Smaller Companies (Cont'd)** | | | | | | | | | | | |
| Moorgate Smcos Inc | 11.79 | 66 | 0.00<br>(-0.41) | 0.01<br>(0.61) | -0.02<br>(-0.12) | -0.01<br>(-0.06) | 0.89<br>(3.05) | 0.05<br>(0.95) | -0.02<br>(-0.04) | 0.38<br>(0.81) | -0.32<br>(-2.62) |
| Murray Enterprise | 13.86 | 163 | -0.02<br>(-2.11) | 0.04<br>(0.93) | 0.00<br>(0.03) | 0.07<br>(0.32) | 1.20<br>(2.81) | 0.14<br>(3.47) | 0.71<br>(2.65) | 0.02<br>(0.18) | 0.09<br>(1.00) |
| Natwest Smaller Cos | 24.68 | 64 | 0.00<br>(-0.41) | 0.02<br>(1.15) | 0.18<br>(1.30) | 0.20<br>(1.27) | 0.51<br>(1.88) | 0.21<br>(2.02) | 0.29<br>(1.09) | 0.14<br>(0.44) | -0.28<br>(-2.22) |
| Perpetual Uk Smcos | 23.96 | 36 | 0.01<br>(0.51) | 0.03<br>(0.70) | 0.07<br>(0.40) | 0.31<br>(1.61) | 0.33<br>(0.99) | 0.11<br>(1.42) | -0.14<br>(-1.13) | 1.10<br>(1.91) | 0.24<br>(1.17) |
| Pilot Inv Tst | 36.70 | 36 | 0.00<br>(-0.01) | 0.02<br>(0.58) | -0.18<br>(-0.88) | -0.09<br>(-0.40) | 1.14<br>(2.85) | 0.12<br>(1.26) | -0.09<br>(-0.49) | 0.66<br>(1.80) | -0.17<br>(-0.95) |
| Saracen Value Tst. | 47.70 | 33 | 0.00<br>(0.41) | -0.02<br>(-1.31) | 0.51<br>(2.63) | 0.28<br>(1.32) | 0.13<br>(0.37) | 0.35<br>(2.41) | 0.74<br>(1.77) | 0.12<br>(0.40) | -0.03<br>(-0.24) |
| Shires Smaller Cos | 30.55 | 52 | 0.00<br>(-0.80) | 0.00<br>(0.20) | -0.39<br>(-2.79) | -0.36<br>(-2.38) | 0.69<br>(2.79) | 0.04<br>(0.67) | 0.36<br>(3.27) | 0.35<br>(1.34) | -0.13<br>(-1.04) |
| Smaller Companies It. | 29.28 | 73 | 0.00<br>(-0.53) | 0.00<br>(0.03) | 0.37<br>(2.50) | 0.23<br>(1.37) | 1.02<br>(3.74) | 0.24<br>(2.65) | 0.04<br>(0.26) | 0.25<br>(1.31) | 0.00<br>(-0.02) |
| St.Andrew Trust | 18.27 | 191 | 0.00<br>(1.25) | -0.01<br>(-0.25) | -0.09<br>(-1.99) | 0.03<br>(0.39) | 0.61<br>(5.50) | 0.09<br>(2.88) | 0.25<br>(2.26) | 0.20<br>(1.37) | -0.02<br>(-0.24) |
| Throgmorton Pf Inc | 33.65 | 38 | 0.02<br>(1.71) | 0.07<br>(2.73) | -0.10<br>(-0.33) | 0.10<br>(0.33) | -0.25<br>(-0.50) | 0.65<br>(3.85) | 0.12<br>(0.29) | -0.19<br>(-0.75) | -0.27<br>(-1.45) |
| Throgmorton Trust | 29.88 | 191 | -0.01<br>(-3.33) | 0.01<br>(0.18) | 0.39<br>(5.32) | -0.07<br>(-0.57) | 0.49<br>(2.54) | 0.25<br>(4.97) | 0.17<br>(0.72) | -0.04<br>(-0.26) | -0.07<br>(-0.92) |
| Tr Smaller Companies | 34.06 | 191 | 0.00<br>(-0.61) | 0.00<br>(0.12) | 0.21<br>(4.46) | -0.04<br>(-0.55) | 0.69<br>(5.25) | 0.04<br>(1.50) | 0.39<br>(3.05) | 0.21<br>(1.37) | -0.30<br>(-4.75) |
| **North America** | | | | | | | | | | | |
| American Oppor Tst | 30.65 | 87 | 0.00<br>(-0.09) | 0.02<br>(0.82) | -0.16<br>(-0.90) | 0.46<br>(2.06) | 0.88<br>(3.95) | 0.20<br>(2.61) | 0.36<br>(1.11) | -0.15<br>(-0.72) | 0.09<br>(0.87) |
| American Trust | 44.93 | 191 | 0.00<br>(0.14) | 0.03<br>(1.10) | -0.01<br>(-0.19) | -0.19<br>(-2.69) | 0.68<br>(10.19) | 0.16<br>(3.28) | 0.15<br>(1.43) | 0.13<br>(0.96) | -0.18<br>(-3.16) |
| American Tst 'B' | 45.21 | 191 | 0.00<br>(-0.87) | 0.01<br>(0.50) | -0.04<br>(-0.75) | -0.13<br>(-1.64) | 0.72<br>(10.34) | 0.15<br>(3.42) | 0.15<br>(1.69) | 0.11<br>(0.86) | -0.18<br>(-3.16) |
| Canadian General Inv | 22.77 | 21 | -0.11<br>(-2.33) | -0.07<br>(-1.53) | -0.22<br>(-0.17) | 0.79<br>(0.94) | 0.48<br>(0.63) | 1.01<br>(2.89) | -1.66<br>(-0.72) | 0.87<br>(1.46) | 0.20<br>(0.72) |
| F&C Us Smaller Cos | 34.71 | 47 | 0.01<br>(1.33) | 0.06<br>(2.85) | 0.24<br>(1.22) | -0.43<br>(-1.99) | 0.48<br>(2.44) | 0.28<br>(2.52) | 0.04<br>(0.15) | -0.11<br>(-0.42) | -0.04<br>(-0.27) |
| Fleming American | 42.56 | 191 | 0.00<br>(0.68) | -0.03<br>(-0.78) | 0.01<br>(0.24) | -0.07<br>(-0.81) | 0.65<br>(8.57) | 0.09<br>(2.51) | 0.69<br>(5.23) | 0.43<br>(3.73) | -0.12<br>(-2.00) |
| Govett Amer.Smcos | 58.77 | 54 | 0.01<br>(1.02) | -0.05<br>(-2.09) | 0.01<br>(0.08) | -0.06<br>(-0.32) | 1.25<br>(7.00) | 0.42<br>(2.77) | 0.25<br>(0.99) | 0.14<br>(0.85) | -0.01<br>(-0.06) |
| North Atlantic Smcos | 30.16 | 191 | 0.00<br>(-1.20) | -0.10<br>(-2.00) | 0.44<br>(5.40) | 0.39<br>(3.04) | 0.27<br>(2.42) | 0.08<br>(2.71) | 0.17<br>(1.02) | 0.40<br>(4.34) | -0.09<br>(-1.41) |
| Us Smaller Companies | 50.32 | 64 | -0.01<br>(-1.17) | 0.01<br>(0.66) | 0.28<br>(1.92) | 0.48<br>(2.96) | 0.84<br>(4.89) | 0.07<br>(1.58) | -0.28<br>(-0.66) | 0.51<br>(1.91) | -0.23<br>(-2.21) |
| **Far East: excluding Japan** | | | | | | | | | | | |
| Abtrust New Dawn | 47.15 | 78 | -0.02<br>(-3.59) | 0.05<br>(1.38) | 0.08<br>(0.63) | 0.07<br>(0.53) | 0.91<br>(5.15) | 0.50<br>(4.06) | 0.24<br>(1.73) | 0.27<br>(1.32) | -0.05<br>(-0.45) |
| Abtrust New Thai | 20.83 | 83 | -0.02<br>(-1.61) | -0.03<br>(-1.06) | 0.31<br>(1.80) | 0.24<br>(1.28) | 0.42<br>(1.76) | 0.18<br>(2.01) | -0.07<br>(-0.38) | 0.09<br>(0.71) | -0.07<br>(-0.63) |
| Australian Opps | 26.69 | 111 | 0.00<br>(-0.41) | -0.05<br>(-2.21) | 0.23<br>(2.69) | 0.18<br>(1.31) | 0.23<br>(2.33) | 0.32<br>(4.03) | -0.24<br>(-1.47) | 0.05<br>(0.77) | -0.07<br>(-0.70) |
| Edinburgh Dragon Tst. | 41.52 | 110 | 0.01<br>(1.93) | 0.11<br>(2.08) | 0.15<br>(1.06) | -0.09<br>(-0.56) | 0.67<br>(3.98) | 0.40<br>(4.77) | 0.03<br>(0.09) | 0.06<br>(0.36) | -0.22<br>(-2.74) |

Table A1. Multi-Factor Regressions (Cont'd).

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| **Far East: excluding Japan (Cont'd)** | | | | | | | | | | | |
| Edinburgh New Tiger | 35.65 | 34 | 0.00 | -0.03 | 0.25 | -0.40 | 0.69 | 0.08 | 1.49 | 0.32 | -0.11 |
| | | | (-0.15) | (-1.14) | (0.78) | (-1.09) | (1.44) | (0.79) | (2.35) | (1.47) | (-0.60) |
| Edinburgh Java It | 24.74 | 78 | 0.00 | 0.04 | 0.35 | 0.42 | -0.04 | 0.25 | 1.55 | 0.01 | -0.17 |
| | | | (-0.53) | (1.23) | (1.61) | (1.79) | (-0.11) | (3.01) | (2.52) | (0.05) | (-1.39) |
| First Philippine | 32.49 | 83 | -0.05 | -0.05 | 0.34 | 0.42 | 0.99 | 0.23 | -0.10 | 0.18 | -0.03 |
| | | | (-2.38) | (-1.58) | (1.69) | (1.80) | (3.28) | (2.82) | (-0.64) | (1.15) | (-0.23) |
| Gartmore Emrg.Pacific | 21.03 | 82 | -0.01 | -0.01 | 0.01 | -0.02 | 0.58 | 0.24 | -0.12 | 0.13 | -0.30 |
| | | | (-1.21) | (-0.46) | (0.10) | (-0.15) | (3.03) | (2.18) | (-0.57) | (0.71) | (-2.46) |
| Govett Asian Smcos | 51.07 | 47 | -0.01 | 0.00 | 0.15 | -0.22 | 1.10 | 0.06 | 0.45 | 0.23 | -0.30 |
| | | | (-0.81) | (0.02) | (0.96) | (-1.25) | (4.08) | (0.53) | (2.12) | (1.89) | (-2.39) |
| Hambros Sm Asian | 56.99 | 26 | -0.01 | 0.00 | 0.69 | 0.32 | 1.25 | 0.33 | 1.66 | 0.20 | -0.12 |
| | | | (-0.49) | (0.21) | (1.65) | (0.88) | (2.73) | (1.30) | (2.58) | (0.54) | (-0.70) |
| Invesco Asia Trust | 39.92 | 17 | 0.00 | 0.01 | 0.56 | 0.78 | 0.61 | 0.39 | 1.19 | 0.74 | 0.02 |
| | | | (-0.24) | (0.82) | (1.50) | (2.05) | (1.55) | (1.09) | (1.87) | (2.47) | (0.09) |
| Invesco Korea | 31.27 | 60 | 0.01 | -0.04 | -0.04 | 0.15 | 0.89 | 0.30 | 0.26 | 0.15 | -0.24 |
| | | | (1.28) | (-1.43) | (-0.20) | (0.73) | (2.76) | (2.89) | (1.05) | (1.38) | (-1.74) |
| Korea Europe Fund | 23.86 | 54 | 0.04 | 0.08 | 0.15 | 0.43 | 0.79 | 0.28 | 0.35 | -0.06 | -0.08 |
| | | | (2.25) | (0.97) | (0.43) | (1.15) | (1.47) | (2.71) | (2.27) | (-0.35) | (-0.55) |
| New Zealand Inv | 20.14 | 74 | 0.01 | -0.12 | 0.08 | -0.26 | 0.53 | 0.22 | 0.05 | 0.06 | -0.02 |
| | | | (1.72) | (-2.53) | (0.44) | (-1.47) | (2.18) | (2.81) | (0.43) | (0.65) | (-0.14) |
| Pacific Horizon | 31.14 | 86 | 0.00 | -0.04 | -0.18 | -0.16 | 1.03 | 0.15 | 0.11 | 0.10 | -0.09 |
| | | | (0.16) | (-1.66) | (-1.23) | (-1.03) | (5.71) | (2.11) | (0.50) | (0.54) | (-0.92) |
| Scottish Oriental Smcos | 22.31 | 21 | 0.03 | 0.01 | 0.06 | -0.08 | 0.97 | 0.54 | -0.01 | 0.22 | -0.30 |
| | | | (1.22) | (0.25) | (0.17) | (-0.23) | (2.12) | (1.40) | (-0.03) | (0.55) | (-1.15) |
| Scottish Asian | 15.25 | 64 | -0.01 | -0.11 | -0.15 | -0.06 | 0.49 | 0.31 | 0.29 | 0.31 | -0.10 |
| | | | (-0.78) | (-2.70) | (-0.66) | (-0.25) | (1.40) | (3.18) | (0.87) | (1.73) | (-0.73) |
| Schroder Asiapacific | 37.43 | 13 | 0.02 | 0.00 | -0.10 | 0.31 | 0.19 | 0.32 | 0.01 | 0.03 | -0.51 |
| | | | (0.43) | (0.17) | (-0.31) | (0.98) | (0.40) | (0.59) | (0.05) | (0.05) | (-1.84) |
| Schroder Korea Fund | 14.10 | 59 | 0.02 | 0.10 | 0.13 | 0.27 | 0.67 | 0.30 | 0.41 | 0.06 | 0.10 |
| | | | (1.29) | (1.77) | (0.35) | (0.64) | (0.97) | (2.58) | (1.95) | (0.31) | (0.66) |
| Siam Selective Gw | 20.89 | 80 | -0.01 | 0.06 | -0.25 | 0.02 | 0.76 | 0.12 | 0.53 | 0.30 | 0.09 |
| | | | (-1.27) | (2.08) | (-1.28) | (0.08) | (2.57) | (2.30) | (1.57) | (2.21) | (0.60) |
| Singapore Sesdaq | 52.32 | 36 | -0.09 | 0.00 | 0.17 | 0.63 | -0.51 | 0.93 | 0.81 | -0.35 | -0.20 |
| | | | (-4.24) | (-0.13) | (0.60) | (1.98) | (-0.96) | (4.59) | (2.05) | (-2.39) | (-1.18) |
| Tr Pacific Inv | 30.54 | 108 | 0.01 | 0.01 | 0.22 | 0.06 | 0.47 | 0.14 | 0.97 | 0.44 | -0.19 |
| | | | (1.26) | (0.34) | (1.74) | (0.37) | (3.66) | (2.21) | (2.83) | (2.31) | (-2.27) |
| **Far East: including Japan** | | | | | | | | | | | |
| Asia Healthcare | 40.09 | 18 | 0.05 | 0.05 | 0.74 | -0.06 | 1.10 | 0.96 | 0.04 | -0.14 | 0.61 |
| | | | (2.97) | (2.69) | (1.43) | (-0.15) | (2.42) | (3.91) | (0.05) | (-0.48) | (2.16) |
| F&C Pacific | 46.31 | 191 | -0.01 | 0.01 | 0.10 | 0.01 | 0.71 | 0.25 | 0.18 | 0.14 | -0.13 |
| | | | (-3.20) | (0.48) | (1.73) | (0.14) | (9.58) | (4.65) | (1.80) | (1.50) | (-2.22) |
| Fleming Far Eastern | 51.96 | 191 | 0.00 | -0.01 | 0.10 | 0.07 | 0.79 | 0.14 | 0.32 | 0.15 | -0.13 |
| | | | (-0.76) | (-0.34) | (2.00) | (0.94) | (11.02) | (3.46) | (2.60) | (1.80) | (-2.43) |
| Govett Oriental | 48.75 | 191 | 0.00 | 0.05 | 0.05 | -0.03 | 0.73 | 0.19 | 0.01 | 0.27 | -0.08 |
| | | | (-0.34) | (1.81) | (1.00) | (-0.33) | (10.50) | (4.25) | (0.13) | (2.46) | (-1.53) |
| Martin Currie Pacific | 41.20 | 138 | 0.00 | -0.03 | 0.27 | 0.18 | 0.60 | 0.22 | 0.12 | 0.14 | -0.15 |
| | | | (-0.80) | (-1.19) | (3.64) | (1.69) | (5.65) | (3.84) | (0.62) | (1.17) | (-1.99) |
| Tr Far East Income | 30.47 | 191 | 0.01 | -0.05 | 0.00 | -0.01 | 0.57 | 0.17 | 0.66 | 0.14 | -0.20 |
| | | | (2.37) | (-1.06) | (-0.04) | (-0.05) | (5.32) | (3.36) | (3.49) | (1.98) | (-3.06) |

Table A1. Multi-Factor Regressions (Cont'd).

| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Japan** | | | | | | | | | | | |
| Baillie Giff Japan | 51 49 | 183 | 0 00 | 0 02 | 0 01 | -0 03 | 0 76 | 0 24 | 0 20 | 0 18 | 0 04 |
| | | | (1 31) | (0 99) | (0 24) | (-0 30) | (11 77) | (4 56) | (1 61) | (1 78) | (0 73) |
| Baillie Shin Nippon | 63 86 | 137 | -0 02 | 0 01 | 0 15 | 0 01 | 0 90 | 0 30 | 0 30 | 0 35 | -0 08 |
| | | | (-3 43) | (0 32) | (2 25) | (0 10) | (10 62) | (4 31) | (1 74) | (2 80) | (-1 17) |
| Edinburgh Japan It. | 49 38 | 53 | -0 01 | 0 03 | 0 12 | 0 16 | 0 79 | 0 37 | 0 51 | 0 43 | -0 08 |
| | | | (-1 95) | (0 76) | (0 63) | (0 77) | (5 15) | (2 29) | (1 08) | (2 06) | (-0 69) |
| Fidelity Japanese Values | 75 47 | 33 | 0 00 | 0 01 | 0 04 | 0 13 | 0 80 | 0 02 | 0 10 | 0 43 | -0 30 |
| | | | (-0 46) | (0 79) | (0 26) | (0 67) | (5 26) | (0 16) | (0 79) | (1 54) | (-2 87) |
| Fleming Japanese | 51 09 | 191 | 0 00 | 0 03 | 0 02 | -0 10 | 0 59 | 0 05 | 0 6" | 0 21 | -0 23 |
| | | | (0 47) | (0 76) | (0 40) | (-1 09) | (9 68) | (2 42) | (4 97) | (2 39) | (-4 20) |
| Gt Japan Inv | 31 16 | 191 | 0 01 | -0 01 | 0 12 | 0 08 | 0 60 | 0 11 | 0 17 | 0 18 | -0 28 |
| | | | (1 42) | (-0.19) | (1 35) | (0 58) | (6 65) | (2 87) | (0 66) | (1 56) | (-4.38) |
| Htr Japan Smcos | 68 11 | 38 | 0 03 | 0 03 | -0 17 | -0 29 | 0 77 | 0 80 | 0 02 | 0 22 | -0 07 |
| | | | (2 74) | (1 60) | (-1 11) | (-1 19) | (4 31) | (3 19) | (0 06) | (1 00) | (-0 60) |
| Invesco Japan Dey | 32 66 | 29 | 0 00 | 0 02 | -0 23 | -0 28 | 0 74 | 0 62 | -0 13 | -0 17 | -0 09 |
| | | | (-0 37) | (0 85) | (-0 84) | (-1 01) | (2 91) | (3 02) | (-0 24) | (-0 46) | (-0 47) |
| Invesco Tokyo Trust | 67 30 | 17 | 0 01 | 0 00 | 0 22 | -0 25 | 1 12 | 0 98 | -0 51 | 0 28 | -0 16 |
| | | | (1 12) | (-0 03) | (0 77) | (-1 40) | (4 26) | (1 91) | (-1 26) | (1 43) | (-0 69) |
| Jf Fledgeling Japan | 57 23 | 152 | -0 01 | 0 02 | 0 10 | 0 00 | 0 78 | 0 36 | 0 06 | 0 44 | -0 08 |
| | | | (-3 12) | (1 00) | (1 44) | (0 00) | (9 65) | (4 74) | (0 24) | (4.61) | (-1 34) |
| Jf Japan Otc | 26 24 | 82 | -0 03 | 0 1" | -0 34 | 0 29 | 0 68 | 0 31 | -0 56 | 0 28 | -0 02 |
| | | | (-2 66) | (2 78) | (-1 51) | (1 04) | (2 84) | (4 00) | (-0 93) | (1 51) | (-0 15) |
| Martin Currie Japan | 83 11 | 18 | 0 03 | 0 02 | -0 30 | 0 05 | 0 92 | 1 03 | 0 71 | 0 15 | 0 29 |
| | | | (1 94) | (1 92) | (-1 08) | (0 25) | (3 49) | (3 46) | (1 78) | (0 49) | (1 51) |
| Perpetual Japan | 69 58 | 41 | 0 01 | -0 01 | -0 15 | -0 42 | 1 04 | 0 15 | 0 20 | 0 21 | -0 16 |
| | | | (0 84) | (-0 37) | (-1 01) | (-2 64) | (9 03) | (1 37) | (1 22) | (1 09) | (-1 43) |
| Schroder Japan Gw | 38 45 | 29 | -0 01 | 0 00 | -0 01 | -0 57 | 0 79 | -0 04 | -0 03 | 0 32 | -0 20 |
| | | | (-0 93) | (0 02) | (-0 07) | (-2 58) | (3 89) | (-0 26) | (-0 32) | (1 50) | (-1 15) |
| **Continental Europe** | | | | | | | | | | | |
| Abtrust Eur Idx | 30 28 | 81 | 0 00 | 0 02 | 0 13 | 0 07 | 0 63 | 0 31 | -0 12 | 0 44 | -0 10 |
| | | | (-0 24) | (1 29) | (1 09) | (0 57) | (3 12) | (2 90) | (-1 08) | (1 83) | (-0 91) |
| Continental Assets | 48 7" | 133 | -0 01 | 0 03 | -0 06 | -0 29 | 1 24 | 0 26 | 0 23 | -0 09 | -0 06 |
| | | | (-2 75) | (1 46) | (-0 78) | (-2 60) | (9 29) | (4 24) | (1 50) | (-0 56) | (-0 87) |
| European Assets Tst. | 33 17 | 155 | 0 00 | 0 01 | 0 25 | 0 15 | 0 62 | 0 16 | 0 25 | -0 05 | -0 07 |
| | | | (0 29) | (0 70) | (3 58) | (1 47) | (5 24) | (3 44) | (1 80) | (-0 39) | (-0 96) |
| F&C Eurotrust | 37 54 | 191 | 0 03 | -0 03 | 0 10 | 0 07 | 0 80 | 0 23 | 0 02 | 0 38 | -0 13 |
| | | | (3 57) | (-0 73) | (1 55) | (0 73) | (7 60) | (3 99) | (0 17) | (3 32) | (-2.02) |
| F&C German | 18 78 | 191 | -0 01 | 0 01 | 0 05 | -0 12 | 0 25 | 0 13 | 0 23 | 0 12 | -0 26 |
| | | | (-1 48) | (0 20) | (0 67) | (-1 14) | (2 49) | (3 04) | (1 61) | (1 19) | (-3 60) |
| Fidelity Eur Values | 64 72 | 28 | 0 01 | -0 10 | -0 26 | -0 01 | 0 75 | 0 23 | 0 04 | 0 57 | -0 21 |
| | | | (0 96) | (-3 59) | (-0 97) | (-0 06) | (1 99) | (1 11) | (0 17) | (2 09) | (-1 28) |
| First Ireland | 26 16 | 80 | -0 03 | 0 03 | 0 15 | 0 13 | 0 38 | 0 36 | 0 02 | 0 17 | -0 12 |
| | | | (-3 15) | (1 31) | (1 12) | (0 81) | (1 60) | (3 45) | (0 07) | (1 36) | (-1 08) |
| Fleming Cont.Europe | 43 92 | 191 | 0 00 | 0 00 | -0 06 | 0 08 | 0 71 | 0 03 | 0 52 | 0 26 | -0 08 |
| | | | (0 41) | (-0 05) | (-1 32) | (1 14) | (10 03) | (1 63) | (5 03) | (2 88) | (-1 51) |
| Fleming Eur Fledge | 33 59 | 79 | 0 00 | 0 03 | -0 03 | 0 13 | 0 80 | 0 31 | 0 01 | 0 40 | -0 05 |
| | | | (0 68) | (1 44) | (-0 27) | (0 97) | (3 95) | (3 40) | (0 04) | (1 80) | (-0 50) |
| Gartmore European | 31 07 | 191 | 0 00 | -0 01 | -0 16 | 0 02 | 0 72 | 0 19 | 0 15 | 0 31 | 0 07 |
| | | | (1 53) | (-0 30) | (-2 68) | (0 17) | (7 47) | (4 15) | (1 44) | (2 83) | (1 00) |
| Gartmore Irish Smcos | 28 08 | 18 | -0 02 | 0 02 | -0 49 | -0 41 | -0 07 | 0 15 | 0 65 | 0 09 | -0 41 |
| | | | (-2 35) | (1 33) | (-1 37) | (-1 37) | (-0.17) | (1 59) | (1 10) | (0 38) | (-1 72) |
| German Inv Tst. | 36 24 | 81 | -0 02 | 0 00 | 0 17 | 0 07 | 0 70 | 0 30 | 0 10 | 0 17 | -0 08 |
| | | | (-2 96) | (0 27) | (1 83) | (0.62) | (3 93) | (3 38) | (1 27) | (1 33) | (-0 80) |

Table A1. Multi-Factor Regressions (Cont'd).

| | | | | | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted R-squared (%) | Obs | Intercept | Dummy | Market | Size | Sentiment | Mean-reversion | Manager | NAV Performance | Reversal |
| **Continental Europe (Cont'd)** | | | | | | | | | | | |
| German Smaller Cos | 39.80 | 76 | -0.03 | 0.06 | 0.06 | 0.17 | 0.97 | 0.20 | 0.18 | 0.24 | -0.08 |
| | | | (-1.64) | (1.56) | (0.50) | (1.21) | (4.74) | (2.00) | (1.74) | (1.26) | (-0.72) |
| Hend.Eurotr Pkg. | 22.84 | 53 | 0.01 | 0.11 | 0.00 | 0.10 | 1.06 | 0.44 | 0.17 | -0.92 | 0.25 |
| | | | (1.46) | (3.12) | (0.02) | (0.46) | (3.27) | (4.12) | (0.40) | (-1.91) | (1.70) |
| Martin Currie Eur | 45.34 | 81 | 0.01 | 0.04 | 0.13 | 0.01 | 0.96 | 0.38 | 0.16 | 0.49 | -0.16 |
| | | | (1.12) | (1.98) | (1.05) | (0.06) | (4.22) | (3.57) | (0.65) | (1.57) | (-1.67) |
| Murray European | 39.91 | 84 | 0.00 | -0.05 | 0.13 | 0.18 | 0.88 | 0.31 | 0.13 | -0.08 | -0.09 |
| | | | (-0.78) | (-2.38) | (1.12) | (1.27) | (4.13) | (3.63) | (0.89) | (-0.36) | (-0.89) |
| Paribas French Inv | 53.65 | 118 | 0.00 | -0.01 | -0.01 | 0.24 | 1.03 | 0.18 | 0.09 | 0.25 | -0.24 |
| | | | (0.14) | (-0.27) | (-0.16) | (2.30) | (7.93) | (2.66) | (0.49) | (2.40) | (-3.31) |
| Second Market Inv Co | 47.17 | 145 | -0.01 | 0.06 | -0.12 | -0.05 | 0.95 | 0.27 | -0.31 | 0.56 | 0.03 |
| | | | (-1.77) | (2.67) | (-1.52) | (-0.43) | (6.71) | (4.43) | (-1.67) | (4.54) | (0.40) |
| Tr European Growth | 38.26 | 75 | 0.01 | -0.03 | 0.06 | 0.09 | 0.94 | 0.21 | -0.42 | 0.30 | -0.01 |
| | | | (1.78) | (-1.90) | (0.52) | (0.66) | (4.70) | (2.84) | (-1.63) | (1.88) | (-0.07) |
| **Average** | **34.73** | **111** | **0.00** | **0.01** | **0.02** | **0.04** | **0.70** | **0.24** | **0.20** | **0.17** | **-0.09** |
| | | | **(-1.60)** | **(2.83)** | **(1.37)** | **(2.77)** | **(29.76)** | **(19.23)** | **(7.77)** | **(9.71)** | **(-10.40)** |
| | | | **{-2.88}** | **{3.53}** | **{1.68}** | **{3.45}** | **{20.07}** | **{37.65}** | **{11.16}** | **{12.63}** | **{-11.61}** |

# Chapter 8

# Opportunities for Future Research

## 1. Introduction

This chapter presents some of the main opportunities for future research on closed-end funds. First, we attempt to characterise the behaviour of UK closed-end funds at the time of the initial public offering (IPO), of seasoned equity offerings (rights and "C" share issues) and of open-ending. We find evidence that the share price tends to decline after the IPO and the decline is particularly strong during the first ten months of trading. Second, we show that the performance of our sample of "dead" funds indicates that funds disappear after periods of poor NAV performance. At open-ending, we find evidence that the share price increases towards NAV. Third, we investigate seasoned equity offerings. We find that funds with good share price and NAV performance tend to have rights and "C" share issues. The evidence suggest that new money flows to well managed funds. Finally, we introduce some analysis relative to the management group and investigate whether some management groups are better than others.

## 2. Initial Public Offering

The underpricing of IPOs has been widely documented in the literature and appears to be a short-run phenomenon. Ritter (1991) investigates the long-run performance during the first three years of public listing. Ritter shows that issuing firms during

1975-84 substantially underperform a sample of matching firms. The underperformance seems to be worse for companies that went public in high-volume years. The evidence tends to suggest that IPO markets are subject to fads and that issuing firms take advantage of these "windows of opportunity". The results are consistent with the argument of Lee, Shleifer, and Thaler (1991) that closed-end funds are issued more frequently in periods of low discounts.

Levis (1993) and Spiess and Affleck-Graves (1995) analyse the long-run performance of UK and US IPOs, respectively. They confirm Ritter's (1991) results. Levis and Thomas (1995) further investigate the UK market and focus on the price performance of closed-end funds. This chapter revisits the long-run performance of closed-end funds listed on the London Stock Exchange and attempts to put into perspective the "anomalous" price behaviour after the IPO. The price decline after the IPO is referred to in Lee, Shleifer and Thaler (1990) as one of the closed-end fund's anomalies. We believe, however, that the long-run underperformance of closed-end funds is similar to the underperformance of industrial IPOs, and need not be regarded as a separate anomaly.

## 2.1. Data and methodology

Blume and Stambaugh (1983) show that the bid-offer effect creates an upward bias to computed single-period returns for individual stocks. Consequently, long term cumulative performance measures suffer from a conceptual drawback as cumulating single-period returns over long intervals implicitly amounts to rebalancing to equal weight each month[159]. Cumulative abnormal returns can be misleading measures of the economic magnitude of performance. The bid-offer bias can be reduced by instead computing the returns on a buy-and-hold portfolio. Conrad and Kaul (1993) and

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[159] Many empirical studies compute portfolio returns as the arithmetic average of the returns on the individual stocks. Since the arithmetic average implies rebalancing to equal weight each period (each constituent is given equal dollar exposure), this calculation gives the return on a rebalanced portfolio.

Canina, Michaely, Thaler and Womack (1998) measure the extent of the bias from cumulating single-period returns over long periods rather than using the buy-and-hold methodology.

We measure the share price buy-and-hold returns from the time of the IPO, $s = 0$, to the first $t$ months of trading, where $t = 1$ to 60. Abnormal returns are computed using the market index (FTSE 100 index) where we assume a beta of 1. The sample consists of 172 funds issued after 1980. Datastream provides price data for all of them. We define the adjusted buy-and-hold returns, $ar_{j,st}$, of fund $j$ from period $s$ to period $t$ as

$$ar_{j,st} = R_{j,st} - I_{st} \tag{8.1}$$

where

$$R_{j,st} = \frac{P_{j,t} - P_{j,s}}{P_{j,s}} \tag{8.2}$$

$$I_{st} = \frac{I_t - I_s}{I_s} \tag{8.3}$$

where $s = 0$, the time of the IPO and $t$ corresponds to the number of months after the IPO. $t = 1$ to 60 months. $P_{j,t}$ and $I_t$ are the fund $j$ share price and the index value at $t$ months after the IPO, respectively. The mean cross-sectional market adjusted return, $AR_t$, is defined as follows:

$$AR_{st} = \frac{1}{n} \sum_{j=1}^{n} ar_{j,st} \tag{8.4}$$

where $n = 172$ funds issued after 1980.

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However, the computed return on the rebalanced portfolio is biased by the average of the bid-offer bias in the individual returns.

Modern portfolio theory assumes that realised returns are lognormally distributed. By the central limit theorem, Cumulative Abnormal Returns (CARs) are approximately normally distributed. However, buy-and hold returns are not normally distributed, especially when measured over long periods. Following Dimson and Marsh (1986), we evaluate their statistical significance using the measure

$$u_{st} = r_{st} - i_{st} \tag{8.5}$$

where $r_{st} = \log_e\left(1 + \bar{R}_{j,st}\right)$ and $i_{st} = \log_e\left(1 + I_{st}\right)$. $\bar{R}_{j,st}$ is the equally weighted average of $R_{j,st}$ over all n funds. The variance of this performance measure is estimated from the single-period abnormal performance, $ar_{t,\,t+1} = ar_{s,t+1} - ar_{s,t}$ and it is equal to

$$Var\ (ar_{s,t}) = T\ Var\ (ar_{t,\,t+1}) \tag{8.6}$$

where $T = t\text{-}s+1$ is the length of the holding period over which performance is measured. The variance of the single-period abnormal return, $ar_{t,\,t+1}$, is estimated from data for the second month of trading. The statistical significance of the buy-and hold returns is estimated based on the following statistic

$$z_{st} = u_{st} \quad \sqrt{Var(ar_{s,t})} \tag{8.7}$$

where the $z_{st}$ statistic is a Student-t distribution with $t\text{-}s$ degrees of freedom.

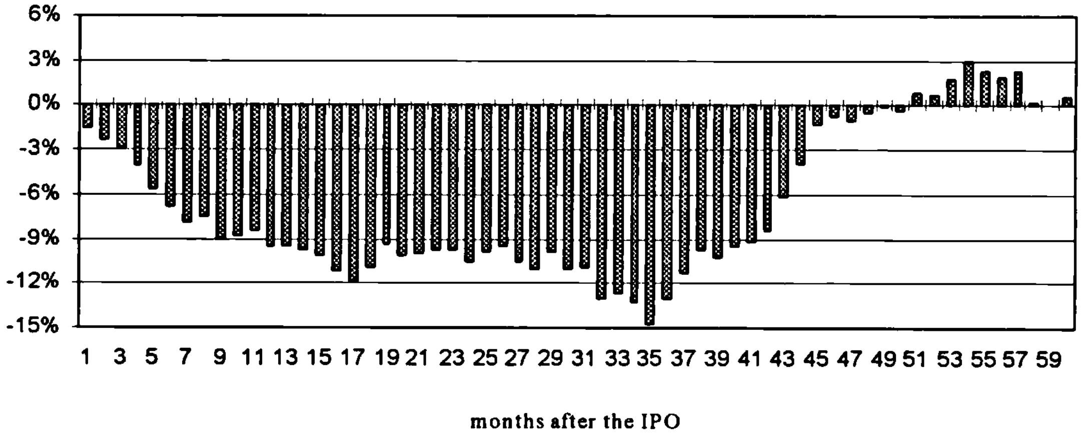
However, when measuring long-horizon abnormal security returns, conclusions require extreme caution. Kothari and Warner (1997) show that tests for long-horizon performance around firm-specific events are severely mis-specified. Using a sample of randomly selected securities and simulated random event dates, they find rejection frequencies, using parametric tests, at times exceeding 30 percent, when the level of significance is 5 percent. They suggest nonparametric bootstrap tests for reducing the problem.

## 2.2. Results

Figure 8.1 below shows the share price abnormal performance after the IPO. Each bar corresponds to the market adjusted buy-and-hold share price performance measured from the month of the IPO ($s$ = 0) to month $t$ of trading, where $t$ =1 to 60 months. The values are the average across the 172 IPOs.

Figure 8.1. Market Adjusted Buy-and-Hold Share Price Returns after the Initial Public Offering

The share price buy-and-hold market adjusted returns (beta =1) are computed from the IPO, $s$ = 0, to the first $t$ months of trading, where $t$ = 1 to 60 months. Market returns are computed using the FTSE 100 index. The Figure plots the equally weighted average abnormal returns, $AR_{st}$, for a sample of 172 funds issued between January 1980 and December 1996. The sample with a full 60 months of history is 71 funds.



Source: Author's calculations using data from Datastream

For the first 36 months of trading, the values of the abnormal buy-and-hold returns are negative and decreasing - closed-end funds underperform the market index. The evidence tends to suggest that the share price decreases after the IPO. The decline is particularly strong during the first ten months of trading. This corresponds to the funds being issued at a premium of about 6 percent to NAV and then moving to a discount within a matter of months. After the first three years of trading, the share price seems to recover.

We find a negative and significant market adjusted buy-and-hold return of -8.8 percent from the IPO to the end of the tenth month of trading. The abnormal performance is significant at the 10 percent level (t-statistic of -1.9).[160] However, buy-and-hold returns measured from the IPO to month *t*, where *t* = 11 to 60 months of trading are not significantly different from zero. The results tend to suggest that the evidence of share price decline after the IPO is particularly strong over the first year of trading.

An interesting question is to determine whether this underperformance during the first three years of trading is particular to closed-end funds or if it has some similarities with industrial IPOs. Levis (1993) uses a sample of 712 UK industrial IPOs during the period 1980-88. He finds cumulative average adjusted returns over 12, 24 and 36 months of +1.57 percent (0.85), -5.2 percent (-1.92) and -11.38 percent (-2.95), respectively. We report the value of the t-statistic for the cumulative returns in brackets. The cumulative performance is measured during the 36 months following the first month of trading. With our sample of 172 closed-end funds we find buy-and-hold adjusted returns over 12, 24 and 36 months of -9.5 percent (-1.67), - 10.5 percent (-1.17) and -13 percent (-1.12), respectively. Again, we report the value of the t-statistic for the buy-and-hold returns in brackets. The abnormal performance is measured relative to the first month of trading. It appears from this analysis that the share price behaviour of closed-end fund IPOs may be similar to industrial IPOs, with the difference that closed-end funds are characterised by a stronger decline. However, the buy-and-hold returns computed for the closed-end fund industry are not significantly different from zero when measured over the first 12, 24 and 36 months of trading. Furthermore, the underlying assets in closed-end funds are typically listed securities for which we know the market value. The prices of closed-end funds move to a discount within a matter of months, reflecting the importance of management fees. On the other hand, the market value of the net assets of an industrial company is more difficult to estimate and this may mitigate the long-run underperformance (see Neal and Wheatley (1998).

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[160] The results are similar to Levis and Thomas (1995) who find, for a sample of 105 closed-end fund IPOs during the period 1984-92, a market adjusted cumulative return of -8.48 percent after 200 trading days.

### 2.3. Limitations and scope for future research

In this preliminary study we do not consider the impact of dividends and adjust returns only using the FTSE 100 index. In future research we can rectify these weaknesses and introduce other indexes to adjust for factor exposures. The conjecture is that even by taking into account the factors described in Chapter 7, we would still find negative returns following the IPO. However, we believe that if we adjust for the performance of industrial IPOs, we might find that the negative returns disappear. The idea is to create a 'month of seasoning' index, as in Ibbotson (1975), where for each period we would measure the performance of industrial IPOs with a certain age. Furthermore, future research could also attempt to measure any arbitrage profitability during the first months of trading.

## 3. Open-Ending

The UK closed-end fund industry has gone through intense changes and restructuring. According to NatWest Securities (1997), 250 new funds were issued between 1980-1996, with a total market capitalisation of £9.4 billion. On the other hand, there have been several departures from the industry. Datastream provides data for 94 funds that disappeared between 1980-1996. The following study investigates the performance of these funds during the months preceding their disappearance[161]. Takeovers, liquidations and unitisations are referred to as open-ending.

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[161] For a fund undergoing restructuring, the Formula Asset Value (FAV) is calculated by taking NAV less x % representing the difference between the NAV and the likely realisable value of the underlying investments.

## 3.1. Takeover, liquidation and unitisation.

A number of investment trusts, including most of the Split Capital Trusts, have fixed dates on which they are to be wound-up but any investment trust can seek shareholder approval for a winding up at any time. The discount to NAV on these trusts narrows as the winding-up date approaches. Upon winding-up, domestic shareholders can end up with potential capital gains tax liabilities. In these instances, a rollover vehicle is typically made available.

Another method of eliminating the discount is to transform the investment trust into a unit trust[162] - the price of units reflecting the value of the underlying investments. Investors exchanging investment trust shares for units are not liable for any capital gains tax until they sells the units. Partial unitisation is a newer variation. Investors are given the choice of opting for a unit trust or for continuing with a smaller investment trust.

Finally, and particularly during periods of large discounts, closed-end funds have been the target of raiders[163] (such as hedge funds), seeking to realise assets that have been undervalued by the market.

## 3.2. The discount of open-ended funds

The first characterisation of the funds that have disappeared is to measure their average discount during the last five years of trading. We define the average discount as the logarithm of the mean price to NAV ratios (see Section 2 of Chapter 4) across the 94 "dead" funds. Figure 8.2 shows the results. The funds seem to have traded at a large discount - an average of 20 percent - during the last years of trading. The discount disappears when the fund is open-ended, but share prices react long before that. During the last year of trading the discount gradually moves towards zero, particularly during the last 6 months of trading.

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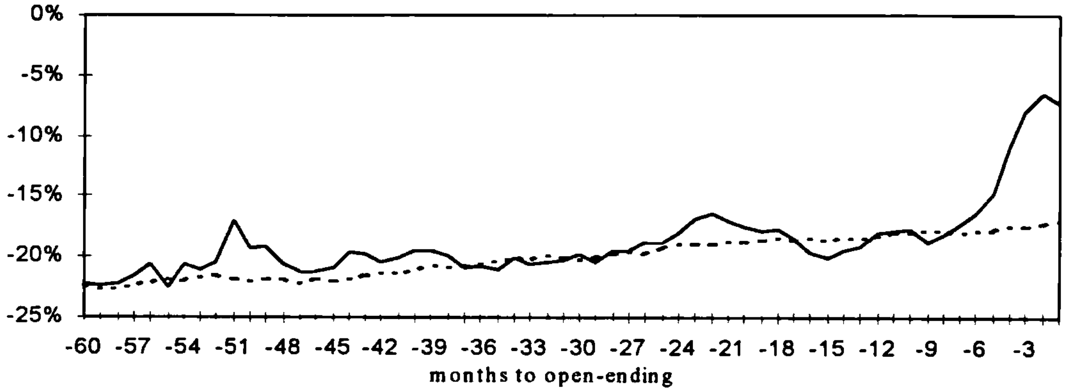
[162] Unitisation involves the repayment of existing debentures, loan stocks, foreign currency loans and preference shares and financing these repayments requires the sale of a varying proportion of the assets of the company.

[163] Big City institutions have also attempted to use the voting power of their stake in the investment trust shares to persuade the management to come up with schemes for eliminating the discount.

Figure 8.2. Average Discount before Open-Ending.

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 funds that disappeared during the period from January 1980 to December 1996. The dotted line corresponds to the average discount for the investment trust industry at $s$ = -60 to -1.



Source: Author's calculations using data from Datastream

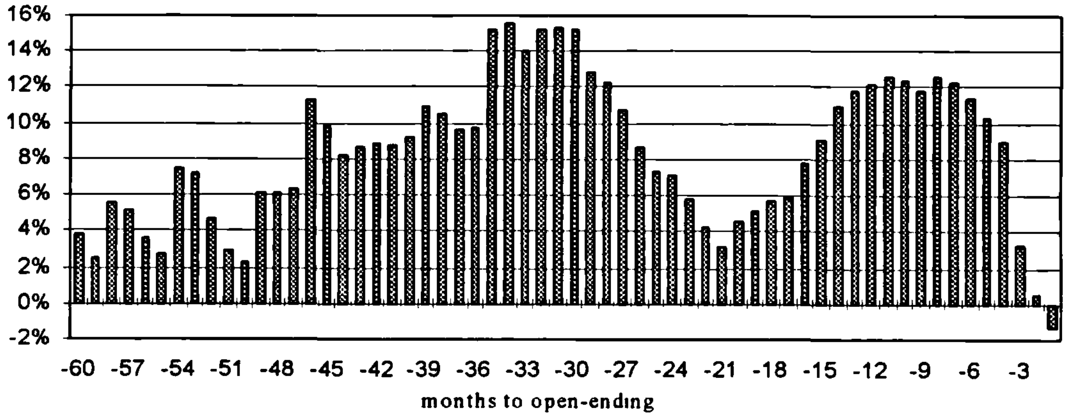
The comparison of the average discount of the funds that disappeared and the average discount for the investment trust industry (dotted line) tends to suggest that "dead" funds did not trade at a substantially larger discount. Instead, the results show that, consistent with the evidence presented in subsequent sections, open-ended funds are characterised by a poor NAV performance.

### 3.3. Share price performance of open-ended funds

The behaviour of the funds that open-ended must also be characterised in terms of their share price performance during the month before open-ending. We measure the performance using the buy-and-hold methodology described by Equations (8.1) to (8.4). Market adjusted buy-and-hold returns are measured from period $s$ to period $t$, where $t = 0$ is the month of open-ending and $s$ = -60 to -1 corresponds to the months preceding the event. The significance of the buy-and-hold returns is measured using the statistic described in Equations (8.5) to (8.7), where the variance of the single-period buy-and-hold returns is evaluated using data for the month preceding the event.

Figure 8.3. Market Adjusted Share Price Buy-and-Hold Returns before Open-Ending.

The adjusted buy-and hold share price returns are computed from month *s*, where $s$ = -60 to -1, to open-ending ($t = 0$). The buy-and hold returns are adjusted using the FTSE 100 index, assuming a beta of 1. The results are the equally-weighted average for the 94 funds that open-ended during the period January 1980 to December 1996.



Source: Author's calculations using data from Datastream

Figure 8.3 shows the abnormal share price performance of the funds that open-ended. Each bar corresponds to the market adjusted buy-and-hold share price performance measured from month *s*, where $s$ = -60 to -1, to open-ending ($t$ = 0). The values are the equally-weighted average across 94 funds that open-ended between January 1980 and December 1996. Table 8.1 reports t-values for the buy-and-hold returns.

The positive adjusted buy-and-hold returns show that, on average, closed-end funds that are terminated outperform the index. The results for the last two years of trading tend to suggest that share prices react to the likelihood of open-ending and rise towards NAV. During the three months of trading the abnormal performance decreases, suggesting that all the information about open-ending has already been incorporated in the price. However, Table 8.1 shows that the abnormal share price performance during the month preceding open-ending is not significantly different from zero.

Table 8.1. Market Adjusted Share Price and NAV Buy-and-Hold Returns Before Open-Ending.

The adjusted buy-and hold share price and NAV returns are computed from month $s$, where $s = -60$ to $-1$, to open-ending ($t = 0$). The buy-and hold returns are adjusted using the FTSE 100 index, assuming a beta of 1. The results are the equally-weighted average for the 94 funds that open-ended during the period January 1980 to December 1996. t-statistics are computed using the measure described in Equations (8.5) to (8.7). Significance levels are denoted by *** (1% level), ** (5% level) and * (10% level).

| | Share Price Returns | | NAV Returns | |
|---|---|---|---|---|
| Months to Open-Ending | Adjusted Return (%) | t-statistic | Adjusted Return (%) | t-statistic |
| -1 | -1.37 | (-0.55) | -0.57 | (-1.40) |
| -6 | 11.34 | (1.66) | -0.95 | (-1.52) |
| -12 | 12.20 | (1.19) | -3.08 | (-1.58) |
| -18 | 5.73 | (0.44) | -8.20 | (-2.10) ** |
| -24 | 7.09 | (0.44) | -10.02 | (-2.31) ** |
| -30 | 15.26 | (0.77) | -8.52 | (-3.40) *** |
| -36 | 9.77 | (0.43) | -12.71 | (-3.88) *** |
| -42 | 8.82 | (0.34) | -14.46 | (-3.79) *** |
| -48 | 6.11 | (0.20) | -15.30 | (-1.66) * |
| -54 | 7.42 | (0.22) | -17.84 | (-1.73) * |
| -60 | 3.84 | (0.10) | -13.34 | (-1.52) |

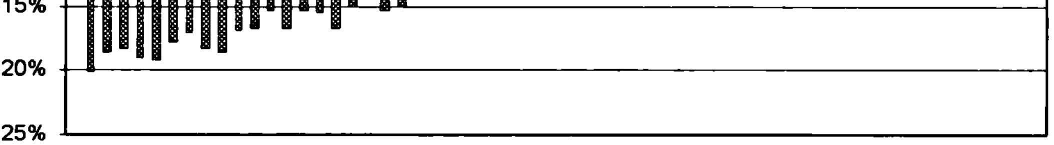
## 3.4. NAV performance of open-ended funds

The previous section shows open-ended funds cannot be characterised by share price returns significantly different from zero. However, their behaviour must also be analysed in terms of their NAV performance. We measure the performance using the buy-and-hold methodology described by Equations (8.1) to (8.4) in Section 2, where we replace fund share prices with NAV. Market adjusted buy-and-hold returns are measured from period $s$ to period $t$, where $t = 0$ is the month of open-ending and $s = -60$ to $-1$ corresponds to the months preceding the event. The significance of the buy-and-hold returns is measured using the statistic described in Equations (8.5) to (8.7), where the variance of the single-period buy-and-hold returns is evaluated using data for the month preceding the event.

Figure 8.4 shows abnormal NAV performance of the funds that open-ended. Each bar corresponds to the market adjusted buy-and-hold NAV performance measured from month *s*, where $s$ = -60 to -1, to open-ending ($t$ = 0). The values are the equally-weighted average across 94 funds that open-ended between January 1980 and December 1996. Table 8.1 above reports the t-values for the returns. The results tend to indicate that closed-end funds that are terminated are characterised by a very poor performance of the underlying assets relative to the market.

Figure 8.4. Market Adjusted NAV Buy-and-Hold Returns Before Open-Ending.

The adjusted buy-and hold NAV returns are computed from month *s*, where $s$ = -60 to -1, to open-ending ($t$ = 0). The buy-and hold returns are adjusted using the FTSE 100 index, assuming a beta of 1. The results are the equally-weighted average for the 94 funds that open-ended during the period January 1980 to December 1996.



Source: Author's calculations using data from Datastream

The negative adjusted buy-and hold returns suggest that the NAV underperformed the market index for the five years before open-ending. The underperformance is significant at the 1 percent level for $s$ = -42 to -30 and at the 5 percent level for $s$ = -30 to -18. During the last year of trading, the underperformance is not significantly different from zero, indicating that the funds have a neutral performance relative to the market index. The evidence suggests that the funds tend to behave like a passive portfolio, probably as a result of having been put into restructuring.

## 3.5. Managerial performance of open-ended funds

Finally, we investigate the performance of the manager during the critical months before the termination of the fund. Managerial performance is measured using returns-based style analysis. The value added by active management is computed after adjusting for the funds' effective asset exposure. Equations (5.3) and (5.4) describe the computation of monthly selection returns. Managerial performance is measured using NAV returns. The fund *j* cumulative selection returns to month *T*, $csr_{j,T}$, is computed as follows.

$$csr_{j,T} - \sum_{t=0}^{T} S_t \qquad (8.8)$$

where $T = -1$ to $-36$. The mean cross-sectional cumulative selection return, $CSR_T$, is calculated:

$$CSR_T = \frac{1}{n} \sum_{j-1}^{n} csr_{j,T} \qquad (8.9)$$

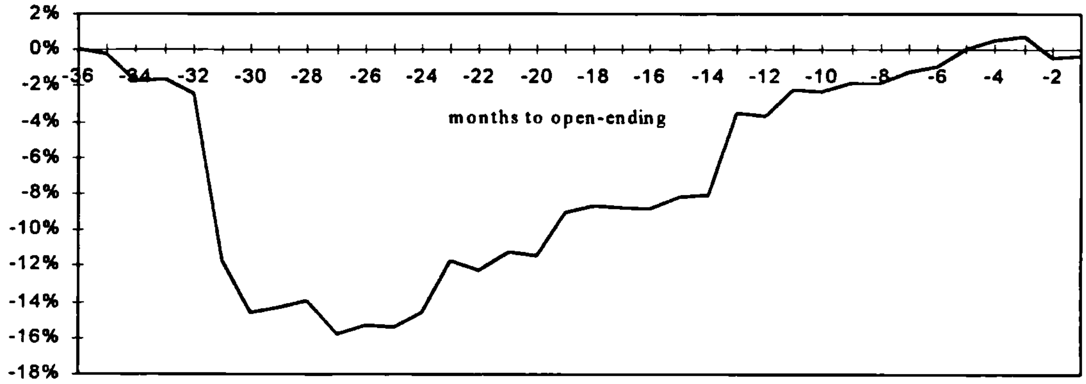
where $n = 94$ funds that open-ended between January 1980 and December 1996. The statistical significance of the $CSR_T$ is evaluated using the t-statistic:

$$t = \frac{CSR_T\sqrt{N}}{\sqrt{T\ Var_T}} \qquad (8.10)$$

where $N$ is the number of observations in month $T$ and $Var_T$ is the cross-sectional variance of the adjusted returns in month $T$. Figure 8.5 shows the returns cumulated over the 36 months preceding the open-ending. We cumulate the monthly abnormal returns from month $T$ to open-ending, where $T = -1$ to $-36$. Table 8.2 reports the t-statistics for the returns.

Figure 8.5. Average Cumulative Managerial Performance.

The selection returns are cumulated from the month of open-ending to T months preceding the event, where T= -1 to -36. The Figure plots the mean cross-sectional cumulative selection return. Managerial performance is measured using returns-based style analysis. The results are the equally-weighted average for the 94 funds that open-ended during the period January 1980 to December 1996.



Source: Author's calculations using data from Datastream

The results tend to suggest that managers, on average, underperform the passive portfolio before open-ending. The selection returns cumulated over the last two years of trading, -14.6 percent, are significant at the 1 percent level. However, consistent with the NAV performance, we find that managers do not seem to do any 'stock picking' during the last year of trading, but rather act as passive mangers.

Table 8.2. Cumulative Managerial Returns Before Open-Ending.

The selection returns are cumulated from the month of open-ending to *T* months preceding the event, where *T*= -1 to -36. The table reports the mean cross-sectional cumulative selection return. Managerial performance is measured using returns-based style analysis. The results are the equally-weighted average for the 94 funds that open-ended during the period January 1980 to December 1996. The computation of the t-statistics is described in Equation (8.10). Significance levels are denoted by *** (1% level), ** (5% level) and * (10% level).

| Managerial Performance | | | | | |
|---|---|---|---|---|---|
| Months to Open-Ending | Cumulative Returns (%) | t-statistic | Months to Open-Ending | Cumulative Returns (%) | t-statistic |
| -1 | -0.37 | (-0.24) | -19 | -9.14 | (-2.55) ** |
| -2 | -0.51 | (-0.23) | -20 | -11.51 | (-3.54) *** |
| -3 | 0.68 | (0.24) | -21 | -11.29 | (-3.80) *** |
| -4 | 0.49 | (0.14) | -22 | -12.24 | (-3.65) *** |
| -5 | 0.06 | (0.01) | -23 | -11.77 | (-3.67) *** |
| -6 | -1.00 | (-0.24) | -24 | -14.64 | (-4.14) *** |
| -7 | -1.30 | (-0.38) | -25 | -15.45 | (-4.40) *** |
| -8 | -1.85 | (-0.49) | -26 | -15.30 | (-4.04) *** |
| -9 | -1.88 | (-0.48) | -27 | -15.79 | (-3.82) *** |
| -10 | -2.37 | (-0.60) | -28 | -13.92 | (-3.50) *** |
| -11 | -2.26 | (-0.53) | -29 | -14.34 | (-4.49) *** |
| -12 | -3.74 | (-0.87) | -30 | -14.64 | (-3.68) *** |
| -13 | -3.51 | (-0.84) | -31 | -11.72 | (-3.14) *** |
| -14 | -8.12 | (-1.66) * | -32 | -2.50 | (-1.36) |
| -15 | -8.22 | (-2.17) ** | -33 | -1.69 | (-1.13) |
| -16 | -8.88 | (-2.28) ** | -34 | -1.77 | (-0.72) |
| -17 | -8.75 | (-2.34) ** | -35 | -0.23 | (-0.11) |
| -18 | -8.74 | (-2.67) *** | -36 | 0.01 | (0.01) |

## 3.6. Limitations and scope for improvements

As discussed earlier, this preliminary study does not account for dividends and adjust returns only using the FTSE 100 index. In future research we can rectify these weaknesses and compare the performance of these funds to both their peers in the AITC category and to the industry overall. Furthermore, we could analyse the factors and obstacles leading to open-ending.

The results show that during the last months of trading, funds that open-ended tend to be neutral relative to the market. Future research could investigate further the reasons for the termination of funds. We would attempt to distinguish between poor management and the presence of the fund in an unpopular sector - thus analysing the contribution of management versus the contribution of the sector. The study would therefore compare relative performance to benchmark performance. Future research could also attempt to identify the benchmark that managers actually aim to beat when they are in a critical position (ie before and during a period of restructuring).

## 4. Seasoned Equity Issues: Rights and "C" Share Issues

Given the fact that open-end funds are bought and sold at NAV and thus management ability may not be priced, Gruber (1996) argues that past performance tends to predict future performance. Evidence that flows of new money into and out of mutual funds follow the predictions of future performance suggests that investors recognise this relationship. In contrast, the "closed" structure of closed-end funds ought to induce the level of discounts to reflect past performance and eventually predict future performance. Chapter 5 shows that discounts weakly reflect past managerial performance, but incorporates no expectations of future performance. However, Gruber's (1996) argument that new money flows to better managed funds could be tested for closed-end funds in terms of rights issues and "C" shares[164] .

In the next sections we characterise the behaviour of the funds that had a rights or a "C" share issue in terms of their discount, adjusted share price and NAV performance during the months preceding the event.

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[164] The additional capital raised by the issue of "C" shares is accounted for as a distinct pool of assets within the fund until the conversion date. The effect of this is that the NAV of the existing portfolio will be unaffected by the introduction of the additional capital and the "C" shares will have an attributable NAV based solely on the net additional capital raised by their issue. "C" shares will be converted into new ordinary shares (or income and capital shares) at or before the conversion date according to a conversion ratio. The conversion takes place after most of the capital raised has been fully invested.

## 4.1. Methodology

We measure share price and NAV performance using the buy-and-hold methodology described by Equations (8.1) to (8.4). Market adjusted buy-and-hold returns are measured from period $s$ to period $t$, where $t = 0$ is the month of open-ending and $s = -60$ to $-1$ corresponds to the months preceding the event. The significance of the buy-and-hold returns is measured using the statistic described in Equations (8.5) to (8.7), where the variance of the single-period buy-and-hold returns is evaluated using data for the month preceding the event.

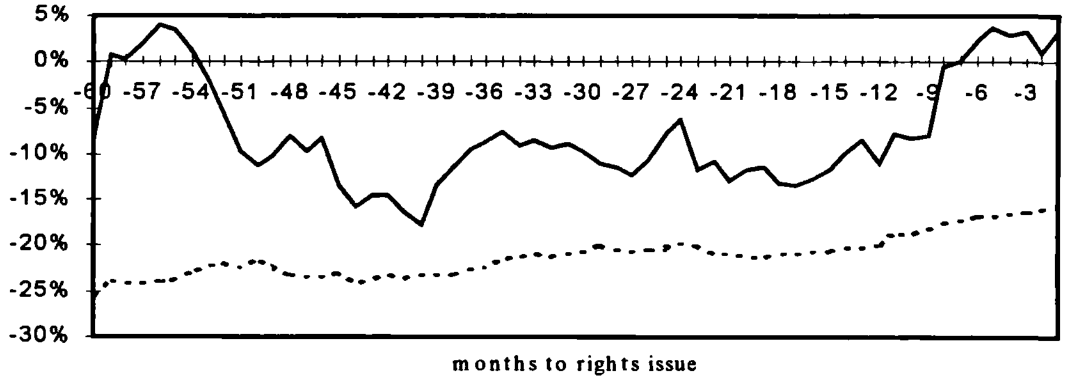
The average discount during the 60 months preceding the rights or the "C" share issue is measured as the logarithm of the average price to NAV ratios (see Section 2 of Chapter 4) across the funds that had the issue during the period from January 1980 to December 1996.

## 4.2. Rights Issues

The average discount for the 22 funds (33 rights issues) during the 60 months preceding the event is described in Figure 8.6. We also plot (dotted line) the average discount for the investment trust industry at $s = -60$ to $-1$. The results show that during the 60 months before the rights issue the funds are characterised, on average, by a smaller discount than the industry. In particular, the funds tend to trade at a premium during the 9 month leading to the rights issues. The evidence is consistent with Burch and Weiss Hanley (1996). Based on a sample of 85 US closed-end fund rights offers issued between 1985 and 1994, they find that managers time rights issues to coincide with periods of low discounts.

Figure 8.6. Average Discount before the Rights Issue.

The average discount during the 60 months preceding the rights issue is measured as the logarithm of the average price to NAV ratios across the 22 funds (33 rights issues) that had an issue during the period from January 1980 to December 1996. The dotted line corresponds to the average discount for the investment trust industry at *s* = -60 to -1.



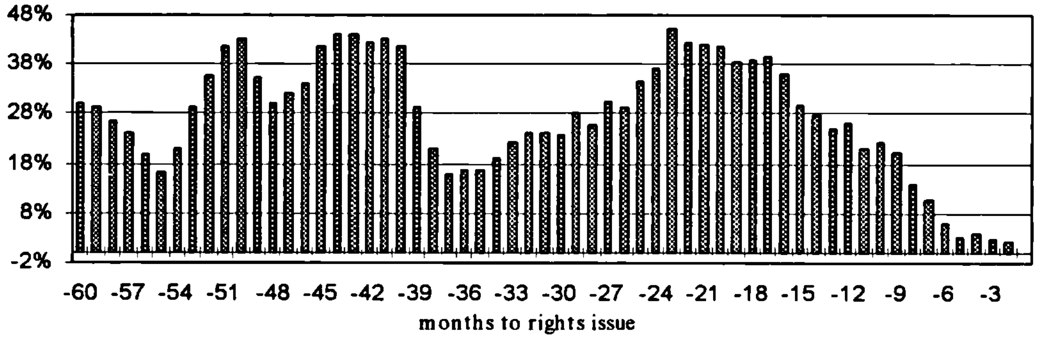
Source: Author's calculations using data from Datastream

Figure 8.7 shows the abnormal share price performance of the funds that had a rights issue. Each bar corresponds to the market adjusted buy-and-hold share price performance measured from month *s*, where *s* = -60 to -1, to the rights issue (*t* = 0). The values are the equally-weighted average across the 22 funds (33 right issues). Panel A of Table 8.3 reports t-values for the buy-and-hold returns.

The positive adjusted buy-and-hold returns show that, on average, the funds that had a rights issue tend to outperform the market index during the 60 months leading to the event. Panel A of Table 8.3 shows that the buy-and-hold returns are significant at the 10 percent level for *s* = -24 to -12.

Figure 8.7. Market Adjusted Share Price Buy-and-Hold Returns before the Rights Issue.

The adjusted buy-and hold share price returns are computed from month *s*, where *s* = -60 to -1, to the rights issue (*t* = 0). The buy-and hold returns are adjusted using the FTSE 100 index, assuming a beta of 1. The results are the equally-weighted average for the 22 funds (33 rights issues) that had an issue during the period from January 1980 to December 1996.

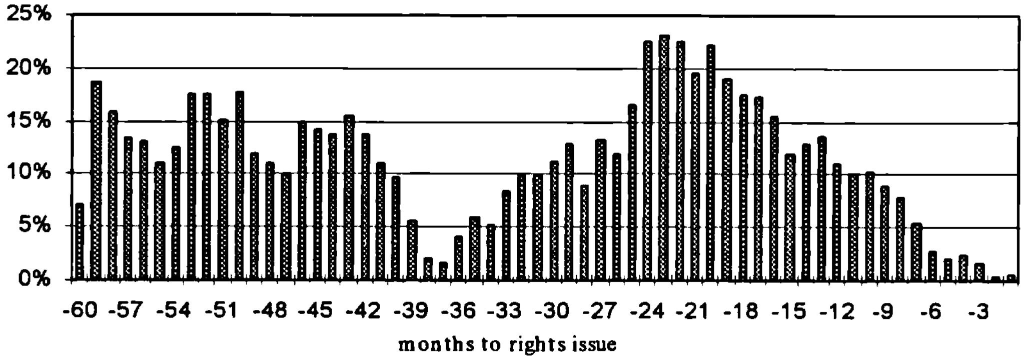


Source: Author's calculations using data from Datastream

The evidence is similar for the NAV buy-and-hold returns. Figure 8.8 shows the results. The average value of the outperformance tends to be lower for the NAV returns. Nevertheless, Panel A of Table 8.3 shows that the adjusted NAV buy-and-hold returns are more significant.

Figure 8.8. Market Adjusted NAV Buy-and-Hold Returns before the Rights Issue.

The adjusted buy-and hold NAV returns are computed from month *s*, where *s* = -60 to -1, to the rights issue (*t* = 0). The buy-and hold returns are adjusted using the FTSE 100 index, assuming a beta of 1. The results are the equally-weighted average for the 22 funds (33 rights issues) that had an issue during the period from January 1980 to December 1996.



Source: Author's calculations using data from Datastream

The results tend to suggest that the funds that have a rights issue are characterised by a good share price and NAV performance during the two years preceding the event.

Table 8.3. Market Adjusted Share Price and NAV Buy-and-Hold Returns Before the Issue.

The adjusted buy-and hold share price and NAV returns are computed from month $s$, where $s = -60$ to -1, to the rights or "C" share issue ($t = 0$). The buy-and hold returns are adjusted using the FTSE 100 index, assuming a beta of 1. Panel A shows the results for rights issues. The values are the equally-weighted average for the 22 funds (33 rights issues) that had an issue during the period from January 1980 to December 1996. Panel B shows the results for "C" share issues. The values are the equally-weighted average across the 32 funds (37 "C" share issues) that had an issue during the period from January 1980 to December 1996. t-statistics are computed using the measure described in Equations (8.5) to (8.7). Significance levels are denoted by *** (1% level), ** (5% level) and * (10% level).

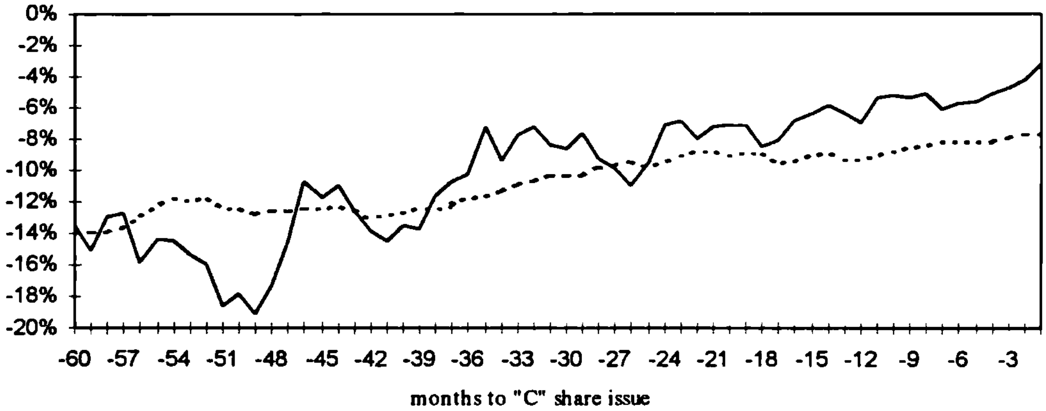
| | Panel A: Rights Issues | | | | Panel B: "C" Share Issues | | | |
|---|---|---|---|---|---|---|---|---|
| | Share Price | | NAV | | Share Price | | NAV | |
| Months to Issue | Adjusted Return (%) | t-stat | Adjusted Return (%) | t-stat | Adjusted Return (%) | t-stat | Adjusted Return (%) | t-stat |
| -1 | -0.14 | (-0.07) | 0.56 | (0.56) | -0.48 | (-0.31) | 1.16 | (0.85) |
| -6 | 6.08 | (0.89) | 2.84 | (1.03) | 7.79 | (1.85) | 6.81 | (1.87) |
| -12 | 26.12 | (2.24) ** | 10.91 | (2.43) ** | 21.26 | (3.15) *** | 17.59 | (3.05) *** |
| -18 | 38.75 | (2.46) ** | 17.57 | (2.93) *** | 28.82 | (3.22) *** | 23.33 | (3.07) *** |
| -24 | 37.20 | (1.96) * | 22.58 | (3.06) *** | 26.55 | (2.58) ** | 23.56 | (2.69) ** |
| -30 | 23.88 | (1.13) | 11.29 | (1.37) | 33.30 | (2.75) ** | 29.00 | (2.82) *** |
| -36 | 16.81 | (0.68) | 4.05 | (0.42) | 54.49 | (3.66) *** | 42.05 | (3.38) *** |
| -42 | 42.25 | (1.41) | 13.79 | (1.21) | 80.29 | (4.35) *** | 52.06 | (3.51) *** |
| -48 | 30.32 | (0.88) | 11.04 | (0.83) | 71.70 | (3.72) *** | 39.62 | (2.59) ** |
| -54 | 21.20 | (0.55) | 12.51 | (0.81) | 64.49 | (3.21) *** | 40.41 | (2.48) ** |
| -60 | 29.98 | (0.65) | 7.17 | (0.40) | 55.79 | (2.45) ** | 38.45 | (2.04) ** |

### 4.3. "C" Share Issues

The average discount for the 32 funds (37 "C" share issues) during the 60 months preceding the event is described in Figure 8.9. We also plot (dotted line) the average discount for the investment trust industry at $s = -60$ to -1. The results show that during the 2 years before the "C" share issue the funds are characterised, on average, by a smaller discount than the industry. During the month preceding the issue, the average discount for the funds is -3.20 percent, whereas the corresponding value for the industry is -7.7 percent.

Figure 8.9. Average Discount before the "C" Share Issue.

The average discount during the 60 months preceding the "C" share issue is measured as the logarithm of the average price to NAV ratios across the 32 funds (37 "C" share issues) that had an issue during the period from January 1980 to December 1996. The dotted line corresponds to the average discount for the investment trust industry at *s* =-60 to -1.



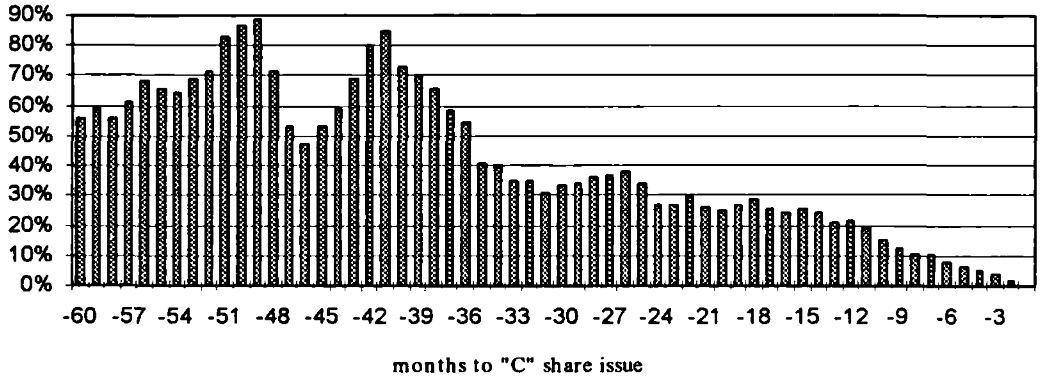
Source: Author's calculations using data from Datastream

Figure 8.10 shows the abnormal share price performance of the funds that had a "C" share issue. Each bar corresponds to the market adjusted buy-and-hold share price performance measured from month *s*, where *s* = -60 to -1, to the "C" share issue (*t* = 0). The values are the equally-weighted average across the 32 funds (37 "C" share issues). Panel B of Table 8.3 reports t-values for the buy-and-hold returns.

The positive adjusted buy-and-hold returns show that, on average, the funds that have a "C" share issue tend to outperform the market index during the 60 months leading to the event. Panel B of Table 8.3 shows that the buy-and-hold returns are significant at the 5 percent level for *s* = -60 to -12. During the nine months leading to the issue, the buy-and-hold returns are still positive, but not significantly different from zero. The results are similar for the NAV performance (Figure 8.11).

Figure 8.10. Market Adjusted Share Price Buy-and-Hold Returns before the "C" Share Issue.

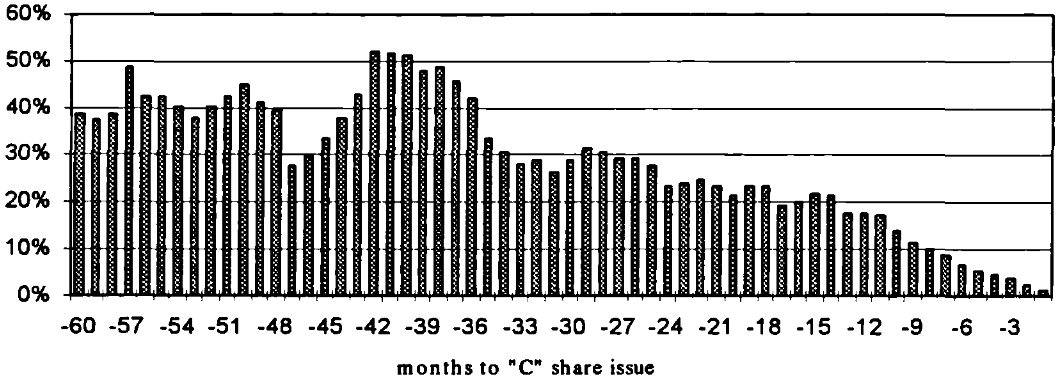
The adjusted buy-and hold share price returns are computed from month *s*, where *s* = -60 to -1, to the "C" share issue (*t* = 0). The buy-and hold returns are adjusted using the FTSE 100 index, assuming a beta of 1. The results are the equally-weighted average across the 32 funds (37 "C" share issues) that had an issue during the period from January 1980 to December 1996.



Source: Author's calculations using data from Datastream

Figure 8.11. Market Adjusted NAV Buy-and-Hold Returns before the "C" Share Issue.

The adjusted buy-and hold NAV returns are computed from month *s*, where *s* = -60 to -1, to the "C" share issue (*t* = 0). The buy-and hold returns are adjusted using the FTSE 100 index, assuming a beta of 1. The results are the equally-weighted average across the 32 funds (37 "C" share issues) that had an issue during the period from January 1980 to December 1996.



Source: Author's calculations using data from Datastream

The results tend to suggest that the funds that had a "C" share offer are characterised by a good share price and NAV performance during the 60 months preceding the event. The share price performance relative to the index is higher when we consider share price returns. Compared to the performance of the funds that had a rights issue, we find stronger results. The adjusted share price and NAV returns are larger and more significant for "C" share issues.

The funds that had a rights and "C" share issues are characterised by a good share price and NAV performance during the month leading to the event. The evidence tends to suggest that new money flows to well managed funds. An important question would be to investigate the behaviour of these funds during the period following the issue and test the hypothesis that new money predicts good performance.

### 4.4. Limitations and scope for improvements

As discussed earlier, this preliminary study does not account for dividends and adjust returns only using the FTSE 100 index. In future research we can rectify these weaknesses. The comparison of the behaviour of seasoned equity issues shows that the funds that have "C" share issues tend to be characterised by a higher share price and NAV positive performance but do not seem to be trading at premiums when they have the issue. However, the event clustering is different; there are few "C" share issues at the beginning and few rights issues at the end of the time period analysed. It is therefore difficult to compare events that do not coexist. But, the results remain interesting and represent opportunities for more research.

## 5. Management Group

In this last section we focus on the management of closed-end funds and we investigate whether some management groups are better than others. We test the hypothesis that the average discount of the funds under specific management groups is significantly lower than the average discount of the other funds in the industry. Table 8.4 shows the results.

Table 8.4. Discount of Management Groups.

The table shows the average discount (%) of the funds under the same management group. Alongside we report the average discount for the industry, where we exclude the management group under investigation. The column [A]-[B] is the difference between the average discount of the group and of the industry. The management groups are ranked by this difference. We test the hypothesis that the average discount of the management group is significantly lower than the industry discount. The last column reports the value of the t-statistics. We use monthly data from January 1980 to December 1996.

| Management Groups | Obs | Average Discount (%) | | | t-statistic |
|---|---|---|---|---|---|
| | | Manag. Group [A] | Industry [B] | [A] - [B] | |
| Schroder | 87 | 5.4 | -10.9 | 16.3 | 9.08 |
| Glasgow Investment Managers | 204 | -5.1 | -18.1 | 13.0 | 17.03 |
| M&G | 59 | 0.8 | -9.5 | 10.2 | 11.85 |
| Exeter Asset Management | 95 | -1.3 | -10.9 | 9.6 | 14.12 |
| Scottish Value | 62 | -2.6 | -9.6 | 7.0 | 11.05 |
| Ivory&Sime | 204 | -15.6 | -17.5 | 2.0 | 3.06 |
| Fidelity | 59 | -7.3 | -9.1 | 1.8 | 3.34 |
| Foreign&Colonial | 204 | -16.0 | -17.5 | 1.4 | 1.79 |
| Martin Currie | 204 | -16.3 | -17.5 | 1.2 | 1.50 |
| Henderson Investors | 204 | -16.9 | -17.4 | 0.5 | 0.64 |
| Gartmore | 204 | -17.3 | -17.4 | 0.2 | 0.24 |
| Finsbury | 204 | -17.9 | -17.4 | -0.5 | -0 51 |
| Kleinwort Benson | 204 | -18.7 | -17.3 | -1.4 | -1.77 |
| Edinburgh Fund Managers | 204 | -19.0 | -17.3 | -1.7 | -2.16 |
| Fleming | 204 | -19.3 | -17.3 | -1.9 | -2.42 |
| Rutherford | 45 | -10.1 | -8.0 | -2.1 | -1.59 |
| Baillie Gifford | 204 | -19.5 | -17.3 | -2.2 | -2.94 |
| Hill Samuel | 140 | -15.8 | -13.4 | -2.4 | -2.95 |
| Abtrust | 88 | -12.6 | -10.1 | -2.4 | -3.44 |
| Murray Johnstone | 204 | -19.9 | -17.3 | -2.6 | -3.11 |
| Perpetual | 103 | -14.3 | -11.0 | -3.3 | -2.76 |
| Stewart Ivory | 204 | -20.8 | -17.3 | -3.6 | -5 01 |
| Morgan Grenfell | 204 | -21.4 | -17.2 | -4.2 | -5.80 |
| Govett (John) | 204 | -21.8 | -17.2 | -4.5 | -6.14 |
| INVESCO | 204 | -23.2 | -17.2 | -6.0 | -6.17 |
| Jupiter | 111 | -21.3 | -11.5 | -9.8 | -9.64 |

The analysis identifies seven groups - Schroder, Glasgow Investment Managers, M&G, Exeter Asset Management, Scottish Value, Ivory&Sime and Fidelity - as the best managers. The average discount of the funds under their management is significantly lower than the discount of the industry. However, Table 8.4 shows that most of the management groups at the top are also characterised by a short history. The results might suggest that "winners" management groups are lucky because of their short history. To answer this question we could in future research look at the growth of open-ended funds under the same management group. The conjecture is that if the funds at the top of the Table 8.4 are "winners", we would expect inflows of money in the open-ended funds that they manage.

Over the past few years there has been a degree of corporate activism in management groups. It would be interesting to see whether management groups that add negative value are taken over by management groups that add positive value to the fund. We could measure the value added by the management using Sharpe's (1992) returns-based style analysis described in Chapter 5.

The results show that the management group tends to affect the discount of the funds under management. The evidence suggests that future research should focus on management. As discussed earlier in this chapter, it would be interesting to analyse the factors and obstacles leading to open-ending. A possibility would be to investigate the management contracts and the management ownership structure in conjunction with this analysis.

## 6. Conclusion

This last chapter attempts to characterise the behaviour of UK closed-end funds at the time of the IPO, of seasoned equity offerings (rights and "C" share issues) and of open-ending.

We find evidence that share prices tend to decline after the IPO. The decline is particularly strong during the first ten months of trading. This corresponds to the funds being issued at a premium to NAV of about 6 percent and then moving to a discount within a matter of months. It would be interesting to extend this analysis and introduce a 'month of seasoning' index of industrial IPO performance. The conjecture is that the negative returns for closed-end fund IPOs would disappear after adjusting for the performance of industrial IPOs.

The performance of or sample of "dead" funds suggests that funds disappear after periods of poor NAV and managerial performance. At open-ending, we find evidence that share prices increase toward NAV. Future research might involve the analysis of other factors leading to open-ending and distinguish between the contribution of the management versus the contribution of the sector.

We also investigate seasoned equity offerings. We find that funds with good past share price and NAV performance tend to have rights and "C" share issues. The evidence suggests that new money flows to well managed funds. The important question that needs to be investigated is whether money flows predict future performance.

Lastly, we investigate whether some management groups are better than others. We test the hypothesis that the average discount of the funds under certain management group is significantly lower than the average discount of the other funds in the industry. The analysis identifies seven groups - Schroder, Glasgow Investment Managers, M&G, Exeter Asset Management, Scottish Value, Ivory&Sime and Fidelity - as the best managers. The average discount of the funds under their management is significantly lower than the discount of the industry. The evidence that the identity of the management group tends to affect discounts suggests that future research should focus on the impact of the management group on fund attributes.

# Chapter 9

## Conclusion

Closed-end funds are characterized by one of the most puzzling anomalies in finance - the existence and behaviour of the discount to NAV. Closed-end fund shares are issued at up to a 10 percent premium to NAV. This premium represents the underwriting fees and start-up costs. Subsequently, within a matter of months, the shares trade at a discount, which persists and fluctuates according to a mean-reverting pattern. Upon termination (liquidation or 'open-ending') of the fund, share prices rise and discounts disappear. Discounts on UK traded closed-end fund companies share many similarities with their US counterparts.

The first part of this study describes the closed- and open-end fund industries and extensively reviews the literature on closed-end fund discounts. Many theories suggest an explanation for the existence and behaviour of the discount, but since none solve all parts of the anomaly, some scholars have found it necessary to resort to models of investor irrationality. This study attempts, however, to describe and characterise the discount on closed-end funds within a rational framework. Chapter 4 deals with the impact of methodological issues.

Given the fact that open-end funds are bought and sold at NAV and thus management ability may not be priced, Gruber (1996) argues that past performance tends to predict future performance. Evidence that flows of new money into and out of mutual funds follow the predictions of future performance suggests that investors recognise this relationship. In contrast, the "closed" structure of closed-end funds ought to induce the level of discounts to reflect past performance and eventually predict future performance. The conjecture is one of the traditional theories of the discount - managerial performance - which claims that discounts reflect the perception of management ability to perform relative to a passive portfolio.

The fact that discounts do not seem to be positively correlated to future NAV returns may explain why so few studies have looked at managerial performance. However, prior tests have focused on raw estimates of NAV returns, and have limited power. The literature implies either that the relationship between discounts and managerial performance does not exist, or that the power of tests based on NAV returns is too low.

The objective of Chapter 5 was to rectify the weakness of using the return on NAV as the definition of managerial performance. We measure performance after adjusting for the risk and factor exposures of the fund. To define the value added by active management we use two methodologies - the unconstrained and the constrained multi-index regression. The first approach follows Gruber (1996) and defines performance as the intercept of a multi-index unconstrained regression. The alternative approach is Sharpe's (1992) returns-based style analysis, in which factor loadings are constrained to be non-negative and add to unity.

Using our sample of UK closed-end funds, we find weak evidence of performance persistence using the seven-factor unconstrained regression. This is consistent with Gruber's (1996) conclusion in his Presidential Address on performance persistence in the US mutual fund industry. However, our evidence is much weaker, and is not supported by the results from the returns-based style analysis. The comparison of the two methodologies tends to suggest that the weak evidence of persistence using the seven-factor model results from drawbacks in the unconstrained regression approach. Consequently, we conclude that there is no performance persistence in the UK closed-end fund market.

Gruber (1996) argues that the price of closed-end funds should incorporate the expectations of managerial performance. The results provide no support for this hypothesis. Discounts weakly reflect past performance, but do not seem to predict managerial performance. The results tend to suggest that practitioners might be wrong in believing that discounts reflect future managerial performance.

Chapter 5 also tests the hypothesis that a fund's residual risk affects the discount. Pontiff (1996) shows that funds with large unhedgeable risk trade at higher discounts. We confirm his results, defining residual risk as the variance of selection returns. The greater the difficulty of hedging - as measured by each fund's residual risk - the higher the discount. This relationship also holds when we use discounts as a predictor of residual risk in subsequent test periods.

In Chapter 6 we investigate the time-series behaviour of UK closed-end fund discounts and extend research previously carried out for the US market. We attempt to characterise the discounts in terms of autocorrelation, stationarity, mean-reversion and cointegration. The idea is to identify some attributes that might drive the model of the discount generating process analysed in Chapter 7. The analysis shows that discounts are highly autocorrelated in their levels but not in their first differences. Nevertheless, we find weak evidence of price reversal. We also show that UK closed-end fund discounts have a tendency to revert to their mean and fluctuate around it within a certain range. A model that attempts to describe the time-series behaviour of the discount must, therefore, account for this pattern. If a fund is trading at a large/small discount compared to the average discount of the category, we would expect the discount to decrease/increase and revert towards this mean. Furthermore, there is strong evidence of UK closed-end fund discounts moving together, in particular within each category of fund. Therefore, for each category, we measure sentiment as the return on an equally-weighted index of changes in the discount, where we include all the funds in a category, with the exception of the fund under investigation. However, the AITC categories might not be the only relevant classification. The conjecture is that management brand might influence the discounts of the funds under the same management. Therefore, for each management group, we measure the "manager" effect as the returns on an equally-weighted index of changes in the discount, where we include all the funds in the management group with the exception of the fund under investigation.

Chapter 7 describes the model of the discount generating process. At first we investigate the importance of Fama-French (FF) type factors in explaining returns and discount changes for UK closed-end funds. The results show that the factors explain closed-end fund share price and NAV returns, but not discount changes. It is not surprising to find that for the discount, essentially an arbitrage portfolio, factors other than the FF-type must be included. We then introduce additional factors in order to explain at least part of the largely idiosyncratic movements in the discount. We investigate the importance of measures of sentiment, mean-reversion, manager, past performance and price reversal.

The multi-factor regression methodology measures the sensitivity of the changes in the discount to the market, size, sentiment, mean-reversion, manager, past performance and reversal factors. The model of the discount generating process seems to capture a significant fraction of the changes in the discount. The seven factors explain, on average, 35 percent of the changes in the discount. The adjusted R-squared is higher than 40 percent for the International General, International Capital Growth, International Income Growth, North America, Far East including Japan and Japan categories. Changes in the discount are particularly sensitive to the sentiment and mean-reversion factors.

Within the framework of the model, we investigate whether for some management groups the manager factor is more significant. The idea is to identify the groups for which the "management brand" has a stronger effect on the discount of the funds under management. We find that for fifteen management groups - M&G, Edinburgh Fund Managers, Kleinworth Benson, Fleming, Govett, Foreign & Colonial, Ivory&Sime, Glasgow Investment Managers, Murray Johnstone, Henderson Investors, Martin Currie, Morgan Grenfell, Exeter Asset Management, Baillie Gifford and Hill Samuel - the estimated slope is significantly different from zero.

Chapter 8 presents some opportunities for future research. We investigate the behaviour of UK closed-end funds at the time of the IPO, of seasoned equity offerings (rights and "C" share issues) and of open-ending. The results show that the price decline during the first years of trading is higher than for industrial IPOs, but bears some similarities. The evidence tends to suggest that the same IPO puzzle pertains to closed-end funds as to industrial companies. The share price decline for closed-end fund IPOs is particularly strong during the first ten months of trading. This corresponds to the funds being issued at a premium to NAV of about 6 percent and then moving to a discount within a matter of months. It would be interesting to extend this analysis and introduce a 'month of seasoning' index of industrial IPO performance. The conjecture is that the negative returns for closed-end fund IPOs would disappear after adjusting for the performance of industrial IPOs.

The second part of the chapter focuses on the departures of funds from the industry. The performance of our sample of "dead" funds tends to suggest that funds disappear after periods of poor NAV performance. At open-ending, we find evidence that share prices increase towards NAV. Future research might involve the analysis of other factors and obstacles to open-ending. We could attempt to distinguish between the contribution of the management and the contribution of the sector.

Gruber's (1996) argument that new money flows to better managed funds can also be tested for closed-end funds in terms of rights and "C" share issues. The third part of Chapter 8 finds that funds characterised by good past share price and NAV performance tend to have rights or "C" share issues. The evidence suggests that new money is raised by well performing funds. The results are particularly significant for our "C" share issues sample. Future research should investigate the behaviour of these funds during the period following the issue and test the hypothesis that new money predicts good performance.

Finally in Chapter 8, we investigate whether some management groups are better than others. We test the hypothesis that the average discount of the funds under their management is significantly lower than the average discount of the other funds in the industry. The analysis identifies seven groups that appear to be the best managers and for whom the average discount of the funds they manage is significantly lower. The evidence that the management group tends to affect the discount of the funds under management suggests that more research should focus on the management. Again, it would be interesting to analyse the factors and obstacles leading to open-ending. A possibility would be to investigate the management contracts and the management ownership structure.

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