Fund Mortality and Fair Discounts on Closed-End Funds

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Abstract

We develop and test a rational model of discounts that takes account of conditional expectations about fund-lives. Previous research has assumed that fund-lives are very long, implying unrealistically large discounts. We find that expected lives are, in fact, short: 10 years or less up to the age of five, then rising slowly to a plateau of 18 years. If dividends are paid, weighted-average lives are even shorter. The model is calibrated to the first 20 years of a fund's life and tested with cross-section data from the UK and US. We conclude that life-expectancy plays a central role in explaining discounts on seasoned funds, but it is not sufficient to explain the premia on new issues.

1. Introduction

1.1 This paper

There are two well-known puzzles about closed-end funds. The first is why they usually trade at discounts, with prices that are below their net-asset values (NAVs).[1] The second is why investors are willing to buy new funds at the time of the initial public offering (IPO), despite evidence that prices on most funds will fall from premia to discounts within a year. Up to now, rational theories of the discount have assumed either that a fund has a very long life (e.g. Berk and Stanton, 2007), or that its life is infinite (e.g. Gemmill and Thomas, 2002; Ross, 2002). In this paper we examine the survival rate of funds and investigate the impact that this has on the 'fair' size of the discount at the different stages of a fund's life. Our aim is to develop and test a rational model of the discount that takes account of conditional expectations about fund lives.

To set the context, Figure 1 gives the average discounts on US and UK equity funds over the 20-year period from 1988 to 2007. There is considerable time-series variation, but the average discount over this period is 6.8% for US funds and 12.8% for UK funds. In other words, discounts are large and volatile in both markets, with larger discounts in the UK than in the US.

Figure 2 is an event-time plot of the behaviour of discounts on 261 new issues in the UK. It shows that the average new issue starts at a premium of around 5%, which then becomes a discount in less than one year and reaches a discount of 10% after three years, which is similar to the contemporaneous discount on seasoned funds. Although the plot in Figure 2 is for the UK, the evidence from new closed-end fund issues in the US is similar (see Shao, 2015). The implied losses from premia turning to discounts make it difficult to explain new issues in a rational framework for either market.

The reason why the price of a fund may differ from its net-asset value (NAV) can be explained quite simply. A fund's price reflects the expected costs and benefits of delegated management over the whole of its life, but its net-asset value (NAV) is the value today of the assets held in the portfolio. There is no simple arbitrage which draws together a fund's price and its NAV unless the fund is liquidated and investors are paid-out the full value of the assets. Arranging for such a liquidation is difficult because managers tend to be entrenched. Because the present value of a fund's costs typically exceeds the present value of the benefits, most seasoned funds will, in order to give the holders of the fund a fair return, trade at a discount (i.e. at a price below the NAV). That discount will be larger the longer the expected period

[1] A premium is defined as (fund price - NAV) / NAV. A discount is a negative premium. In the empirical work, premia carry a positive sign.

before the fund's demise because the longer the period, the smaller the present value of the cash flow from liquidating the assets.[2]

The role of expected life for the discount has been overlooked in previous research. Its importance can be demonstrated with a simple example. Assume that a fund has an infinite life and its portfolio pays 4% in dividends. Assume also that the fund has an expense ratio of 1.5%, but that this cost is partially offset by the implicit benefit from delegated management which is 0.5%. Together these costs and benefits result in a 'net expense ratio' of 1.0%. An investor who purchased the underlying portfolio directly would receive 4% in dividends per annum, but an investor who purchased the fund would receive only 3% per annum (after costs and benefits). A perpetuity comprising a fund's share that pays 3% will be worth only three-quarters as much as one comprising a portfolio which pays 4%, so the fund must trade at a discount of 25%.

This intuition has been shown more formally by Gemmill and Thomas (2002) and Ross (2002), the discount being

$$\frac{-(\gamma-\theta)}{\delta}$$

where γ is the management expense ratio, θ is the benefit from delegated management, and δ is the dividend on the portfolio. Note that if the fund paid no dividends at all after deducting net expenses, this equation would predict an infinite discount.

Now suppose instead that, rather than surviving forever, the fund has an expected life of 20 years. It can then be considered to be an annuity rather than a perpetuity. For the calculation we need to know the required return on shares, which we assume to be 8%. As will be shown later in the paper, if the fund pays no dividends then the revised formula for the discount is

$$\left[\frac{(1+r-\gamma)}{(1+r-\theta)}\right]^n - 1$$

where r is the required return and n is the expected life of the fund. The result for a non-dividend-paying fund using the values in previous example (of 1.5% management fees and 0.5% benefits from delegated management) is a discount of 17.0%. That is, without doubt, a more realistic result than the infinite discount which is generated by the perpetuity calculation for this non-dividend-paying fund.

[2] For discussions of the costs of arbitrage and discounts, see Pontiff (1996, 2006). The effect of entrenched management is examined by Souther (2016).

Extending the example to one in which dividends are paid, the weighted-average life of a fund is shortened because each dividend payment is equivalent to a part of the fund reaching maturity. Suppose there is a 4% dividend yield. The weighted-average life of the example fund then falls from 20 years to 13.7 years and the discount narrows from 17.0% to 14.0%. This level of discount is now similar to those reported in Figure 1.

Because of the importance of expected life for the discount, we begin our paper with an empirical analysis of fund mortality in the UK and US. This shows that median lives are about 10 years at birth, falling to 7 years at age four and then rising to 18 years as funds become fully seasoned. The mortality rate is similar in the two markets. We then turn to the development of a model with rational investors, in which a fund's life is stochastic and conditional on its current age.

We first assume that there are only costs and no benefits from delegated management. This leads to a simple formula, based upon which the computed discount tends to be excessively large. Next we include the benefits of delegated management, such as administrative convenience, diversification gains and liquidity gains, which reduce the discount to a more realistic level. We term these benefits a 'convenience yield'. As the final step in model development, we include dividends. The role of dividends (including capital pay-outs) has generally been ignored by theorists, but not by practising managers who frequently have minimum-dividend policies (MDPs).[3] As already noted, dividends reduce weighted-averages lives (i.e. durations) of funds and therefore have a strongly positive influence on discounts.

The model is calibrated to seasoned funds and then tested with 20 years of panel data on 170 UK and 93 US funds. The results confirm the model's prediction of the importance of expected life for the discount. We then perform a second set of regressions on a unique sample of UK split-capital funds, for which wind-up dates are fixed at the time of issue. The latter regressions, based on up to 91 funds over 8 years, provide further confirmation of the model's prediction of the impact of expected life on discounts.

Having shown that the model works well for seasoned funds, we then turn our attention to new issues. A calibration based on UK and US data indicates that an abnormal return of about 11% is required in the first year after IPO. Rational explanations, based on IPO gains from liquidity or abnormal performance, are reviewed and found unlikely to generate so large a convenience yield. The behaviour of new issues therefore remains a puzzle, suggesting that investors in closed-end fund IPOs have biased expectations.

[3] There have been a few papers that consider the impact of dividends on discounts. Pontiff (1996) recognises that dividends shorten fund lives and therefore facilitate arbitrage. Wang and Nanda (2011) and Cherkes, Sagi and Wang (2014) investigate the impact of MDPs..

1.2 Previous research on discounts

Many papers have been written on the two discount puzzles (see comprehensive reviews by Dimson and Minio-Kozerski (1999) and Cherkes (2012)). Our approach is most closely related to Berk and Stanton (2007) and to Cherkes, Sagi and Stanton (2009). Both papers aim to explain in a rational framework why there are premia on new issues but discounts on seasoned funds. For that sequence to arise there needs to be some change in the mix of benefits and costs over time. Berk and Stanton (2007) assume that initial benefits are large because new managers tend to outperform, while initial costs are low because good managers are not yet able to capture any rent. When these features are reversed after a few years, the initial premium turns to a discount. In fact, under conditions of rationality, the discount in their model would become very large on a seasoned fund unless there were some countervailing effect. Berk and Stanton (2007) therefore assume that a fund has a typical life of 50 years, at which time the fund is liquidated and investors are paid the NAV. Berk and Stanton (2007) provide no empirical tests and a number of their assumptions about new funds appear not to be borne out in practice: namely, those relating to long lives, low initial fees, and good initial performance.

Cherkes, Sagi and Stanton (2009) propose that the gain on new funds arises because a fund provides the investor with access to illiquid assets (the underlying portfolio). It is this liquidity gain, which follows a random walk with drift, that causes discounts to fluctuate over time. For the model to match the evidence from new issues, Cherkes, Sagi and Stanton (2009) require that the liquidity gain from buying a new fund is very large and then diminishes quickly. Although they specify a model in which funds may be terminated, it is not clear in their empirical work the extent to which it affects the observed discounts on either new or seasoned funds.

In contrast to the above papers, Lee, Shleifer and Thaler (1991) dispense with rationality and argue that discounts are the result of investor sentiment. If sentiment leads to a systematic risk, then that risk should be rewarded and generate larger discounts for funds with larger sentiment betas. The problem with testing this theory is the need to identify sentiment before being able to show whether it is priced or not. The discount does not appear to be related to small-firm sentiment (Chen, Kan and Miller, 1993) and the movements of discounts are not very closely related to other proxies for sentiment (Baker and Wurgler, 2006). Even if sentiment is what causes fluctuations in discounts, as Gemmill and Thomas (2002) find for UK funds, unless it is a systematic risk it will not cause funds to trade on average at discounts.

1.3 Structure of paper

Our paper is written as follows. We start in section 2 with an analysis of the evidence on the life-expectancy of funds. In section 3 we outline the model for the premium/discount when returns to investors are fair. This is followed in section 4 by calibration and tests of the model for cross-sections of seasoned funds. Section 5 calibrates the model to new funds and examines whether it is capable of explaining the puzzle of premia turning rapidly to discounts. Section 6 draws together the conclusions of the paper and makes suggestions for further research.

2. The Life-Expectancy of Closed-End Funds

There has been no previous study of life-expectancy for closed-end funds, although there have been many studies of survivorship for open-end mutual funds (starting with Brown, Goetzman, Ibbotson and Ross, 1992). It is reported by Bradley, Brav, Goldstein and Jiang (2010) that about 5% of US closed-end equity funds disappear each year because they are open-ended, merged or liquidated. They also find that the age of a fund has only a small impact on the success rate of open-ending attacks. Assuming 5% per annum disappearance, regardless of current age, the implication from their study would be a median expected life for a US closed-end fund of just 13.5 years.

Our analysis of life-expectancy is based on 261 UK funds which had IPOs from 1984 to 2008 and 181 US funds which had IPOs from 1986 to 2011.[4] Survival of the new funds is tracked to the end of 2015 for the UK funds and to the end of 2014 for the US funds. There are various ways in which a fund may 'die'. Out of the 261 UK funds, 155 (59%) die over the sample period. Of those that die, 32% are open-ended and 30% are liquidated. A complete analysis of what happens to the sample of UK funds is given in Table A1 of the Appendix. This indicates that the demise of a fund leads, in almost all cases, to payment of the NAV to holders of shares (less some small liquidation costs).

One concern which arises from the 'survivorship' literature is that disappearing funds are also those that perform badly. This leads to a bias in the estimated performance of the survivors. However, we are not concerned in our paper with performance but with the discount, i.e. with the market value of a fund relative to the market value of the underlying asset portfolio. While the samples of UK and US funds are

[4] We thank Diana Shao of the University of Florida for providing the US data.

likely to have an upward bias in estimated NAV performance due to survivorship, there is no reason why their discounts should be biased.[5]

The data allow an analysis of mortality versus age for funds with ages up to 25 years. Figure 3 shows that the mortality rates in the two markets are similar. After 25 years, 72% of UK funds and 59% of US funds have died. The mean ages at death are 7.89 for UK funds and 8.56 years for US funds, while the medians are lower at 7.15 and 7.46 years respectively. There are no significant differences across the two markets for the mean or median age at death. If log trends are fitted to the data, as in Figure 4, the proportions of funds dead after 25 years are estimated to be 74% for the UK and 61% for the US. [6]

One way to check whether UK funds have higher mortality rates than US funds (as suggested by Figure 4, although not statistically significant) is to examine the cross-sections of ages for existing funds. If funds have been launched in the two markets at similar times and the UK mortality rate is higher, we would expect to find that the ages of existing UK funds would be smaller than those of existing US funds. Using data from Morningstar, there were, in May 2016, 218 UK equity funds and 175 US equity funds in existence. We exclude from the sample the 40 UK and 6 US funds that are more than 50 years old, because they are likely to have changed character since being launched.[7] This leads to the age distributions for existing funds plotted in Figure 5, from which log trends are shown in Figure 6. The curves for frequency against age in Figure 6 are quite close for the two markets, so this analysis supports the previous conclusion that UK and US fund-mortality rates are similar.

Having determined similar mortality rates in the two markets, we use the UK data on new issues to calculate the median life-expectancy of the funds. This is plotted in Figure 7. It shows that median life-expectancy starts at 10.5 years for a new fund and then falls with increasing age to be only 7.5 years at the age of three. The reason it falls is that hardly any funds die in their first three years of life, so a new fund has a median life-expectancy that is three years greater than for a fund that is already aged three. Life expectancy at age four is similar, at 7.4 years, after which it rises rapidly but at a diminishing rate, to be just under 18 years when a fund is 18 years old. Thereafter the plot indicates a slight shortening of life-expectancy with further age, but this is likely to be due to over-fitting of the line. It seems more plausible

[5] Gemmill and Thomas (2016) confirm empirically that survivorship does not bias the discount on new issues.
[6] If the trends are based on data up to 20 years of age, rather than the 25 years used here, the results are similar.
[7] There are 23 UK funds that are aged more than 100 years (10.6% of the total), whereas there are no US funds exceeding that age.

that median life-expectancy peaks when a fund is about 18 years of age and continues at that level with further age.[8]

To summarise this section, we find that funds have surprisingly short lives, with a median of less than 20 years, and that new funds have even shorter lives, with a median of about 10 years. This information is important in calibrating a model of the rational discount, to which model we turn our attention in the next section.

3. A Model of Rational Discounts

Simple model, life of one year

Consider a fund which incurs management fees but provides no benefits of delegated management and let the fund have a pre-determined life of one year. Its price today will be equal to the expected NAV after one year, discounted at the required rate of return (r):

$$P_t = E(NAV_{t+1}) / (1 + r) \qquad (1).$$

The expected NAV in one year's time is just the current NAV compounded at the required rate less the fees paid for fund-management at rate γ per period:

$$E(NAV_{t+1}) = NAV_t\,(1 + r - \gamma) \qquad (2).$$

Combining (1) and (2) we obtain:

$$P_t = NAV_t\,(1 + r - \gamma) / (1 + r)$$

$$P_t / NAV_t = (1 + r - \gamma) / (1 + r)$$

$$PREM_t = A - 1, \qquad (3)$$

where PREM is premium and $A = (1 + r - \gamma) / (1 + r)$.

As an example, if the rate of management fee, γ, is 1.0% and the required return is 5%, then this one-period fund would trade at a small discount of -1.0/1.05 = 0.95%.

[8] Our analysis of life-expectancy is based on the median rather than the mean because 26% of the funds are still alive after 25 years and their ages at demise cannot be observed.

Simple model, life of two years

Consider next the same fund but with two periods until it will be open-ended. Let the required return, r, be the same in all periods and the rate of management fee, γ, also be constant. There are no dividends.

$$P_t = E(NAV_{t+2}) / (1 + r)^2 \quad (4).$$

$$E(NAV_{t+2}) = NAV_t (1 + r - \gamma)^2 \quad (5).$$

Combining (4) and (5) we obtain:

$$P_t = NAV_t (1 + r - \gamma)^2 / (1 + r)^2$$

$$P_t / NAV_t = \{(1 + r - \gamma) / (1 + r)\}^2 = A^2 \quad (6).$$

$$PREM_t = P_t / NAV_t - 1 = A^2 - 1 \quad (7).$$

The discount on the two-period fund with the previous management fee (γ) of 1.0% and required return of 5% per annum is about twice as negative as on the one-period fund, i.e. 1.90% .

Simple model, many years

Comparing the one-period premium (3) with the two-period premium (7), we see that its size is proportional to the number of periods. Generalising, we find that the n-period premium is

$$PREM_t = A^n - 1 \quad (8).$$

For the example fund, if its expected life is 20 years, then its discount will be 17.4%.

A good approximation to (8) is

$$PREM_t \approx -n\gamma / (1+r) \quad (9).$$

In other words, the discount is roughly proportional to how long a fund is expected to survive. The approximation gives a discount of 19.0% for the 20-year fund (compared with the correct value of the discount of 17.4%).

Figure 8 illustrates how the discount is almost linear in the management expense ratio, ranging from 0% at an expense ratio of zero to a discount of 25.0% at an expense ratio of 1.5%.

Benefits of delegated management: the convenience yield

At the time of a new issue, the expected gains from delegated management must exceed fund costs (management fees), otherwise there would be no reason for an investor to buy the fund. Thereafter the expected gains decline relative to the costs and, in order to give a fair return, the fund price must fall to a discount. Some of the expected gains are stable, well-defined and small, for example: the diversification gain from holding a portfolio of assets; and the administrative gain from delegating the management of the portfolio to a professional manager. Other expected gains are likely to be larger for a new fund than for an old one, for example: the gain from being able to access illiquid assets, such as corporate bonds, emerging-market shares, or property; and the gain from abnormal performance of a particular new fund.

We denote the expected gains at a particular time as the 'convenience yield' of a fund. Because seasoned funds trade at quite large discounts of 5% to 15%, it seems likely that the typical convenience yield for them is small, e.g. in the range of 20 basis points for a relatively simple fund to 80 basis points for a fund which invests in illiquid or 'exotic' assets.

Consider a one-period fund which has a constant convenience yield equal to θ % of the NAV. The price of the fund today is

$$P_t = E(NAV_{t+1}) / (1 + r) + \theta NAV_t \qquad (10).$$

Its expected NAV in the next period is not affected by the convenience yield and is

$$E(NAV_{t+1}) = NAV_t\,(1 + r - \gamma) \qquad (11),$$

which leads to a premium of

$$PREM_t = (P_t / NAV_t) - 1 = \{-\gamma / (1 + r)\} + \theta \qquad (12).$$

Generalising to many periods,

$$PREM_t = B^n - 1 \qquad (13),$$

where $B = (1 + r - \gamma)/(1 + r - \theta)$.

As already noted, the positive effect of the convenience yield (θ) offsets to some extent the negative effect of the management fee (γ). If they were of equal magnitude, then the fund would have a premium of zero. We have suggested that the convenience yield on a seasoned fund is likely to be about 0.2%, as compared with a management fee of (say) 1.0%. Under these example conditions, with an expected life of 20 years and a required return of 5%, the discount would be 14.2%. Without the convenience yield the discount would have been 17.4%.

Figure 9 demonstrates the relationship between the convenience yield and the discount, with the discount ranging from 17.4% with a convenience yield of 0% to a premium of 47.5% with a convenience yield of 3%. It is therefore obvious that the convenience yield can have a large impact, but it should also be noted that this assumes that the yield is constant for the whole of a fund's life, whereas its expected size is likely to be much larger at the time of issue than thereafter (as discussed later in the paper).

Dividends and premia

One might expect dividends to be irrelevant for premia, along the lines of Miller and Modigliani (1961), but that is not correct. The dividend yield (including all other kinds of capital pay-out) has a large positive impact on the premium. The reason is that a dividend-paying fund is equivalent to a portfolio of non-dividend-paying funds, with each fund being liquidated in turn at its NAV. The result is that funds paying dividends pay-out their NAVs earlier, leading to shorter weighted-average lives and smaller discounts.

Starting again with the one-period fund, let there be no convenience yield, an expense ratio of γ, and a dividend to be paid at a rate of δ on the NAV. For simplicity, we assume that the dividend payment is related to the current NAV_t.[9] We then have the current fund price depending on both the final NAV after one period and the dividend to be paid at that time:

$$P_t = \{E(NAV_{t+1}) / (1 + r)\} + \{\delta NAV_t / (1 + r)\} \qquad (14).$$

And the final NAV pay-out is reduced by the dividend which is paid at the rate δ:

$$E(NAV_{t+1}) = NAV_t (1 + r - \gamma - \delta) \qquad (15).$$

Combining (14) and (15):

$$P_t = \{NAV_t (1 + r - \gamma - \delta) / (1 + r)\} + \{\delta NAV_t / (1 + r)\}$$

$$P_t / NAV_t = \{(1 + r - \gamma - \delta) / (1 + r)\} + \{\delta / (1 + r)\}$$

[9] The dividend will be paid on the full portfolio, so in reality it will be somewhere between δNAV_t and $\delta E(NAV_{t+1})$. If we were to assume that the latter is the relevant payment, the calculation would be complicated by a second-order term which is close to zero.

$P_t / NAV_t = (1 + r - \gamma) / (1 + r)$

$$PREM_t = (P_t / NAV_t) - 1 = A - 1 \qquad (16),$$

where $A = (1 + r - \gamma) / (1 + r)$, as already defined earlier in the paper.

It follows that a one-period fund which pays a dividend at a rate δ after one period has the same value as a one-period fund which pays no dividend at all. This is an obvious outcome because the whole fund is liquidated after one period anyway and the fund pays the full NAV at that time (regardless of how the payout is split between the dividend and the asset value).

Turning to a two-period dividend-paying fund, this can be valued as a combination of a one-period zero-dividend fund (comprising the dividend payment) and a two-period zero-dividend fund (including the second dividend payment). The premium on the fund today is then a weighted average of the premia on the two component funds. The formula for the premium becomes quite messy. For the two-period fund it is

$$PREM_t = -1 + (1 - \delta)^2 A^2 + \delta A + \delta(1 - \delta) A^2 \qquad (17).$$

Generalising to n periods, and also including a convenience yield paid at the rate θ per period, we can write

$$PREM_t = B\delta\{1 + \sum_{i=1}^{n-1} B^i (1 - \delta)^i\} + B^n(1 - \delta)^n - 1 \qquad (18),$$

where $B = (1 + r - \gamma)/(1 + r - \theta)$, as already defined.

Figure 10 demonstrates the large impact the dividend yield has on a fund's discount, using the same conditions as before, i.e. an expected life of 20 years, a management fee of 1%, a convenience yield of 0.2% and a required return of 5%. The discount ranges from 14.2% with no dividend to a discount of 6.4% with a dividend yield of 10%.

An indication of the relative importance of the different factors that determine the premium is given in Table 1. It gives premia/discount computed for a fund under two expected lives (10 and 20 years), two expense ratios (0.75% and 2.0%), two convenience yields (0.2% and 1.0%), and two dividend yields (0% and 6%). A required return of 8% is assumed. The range of outcomes is from a premium of 4.78% (for a fund with a 20-year expected life, an expense ratio of 0.75%, a convenience yield of 1.0% and a dividend yield of zero) to a discount of 28.59% (for a fund with a 20-year expected life, an expense ratio of 2.0%, a convenience yield of 0.2% and a dividend yield of zero). [10]

4. Calibration and Tests for Seasoned Funds

This section of the paper focuses on the model's performance in relation to seasoned funds. The analysis is divided into three sub-sections. In the first of these (sub-section 4.1) the model is calibrated to samples of seasoned UK and US funds. In sub-sections 4.2 and 4.3, regressions are used to examine whether there is empirical support for the theoretical model. The first set of regressions (in sub-section 4.2) uses panels of conventional funds in the UK and US, while the second set of regressions (in sub-section 4.3) uses cross-sections of split-capital funds in the UK.

4.1 Calibration for Seasoned Funds

The upper part of Table 2 gives median data to be used for calibration, taken from samples of 170 UK and 93 US seasoned equity funds observed weekly over the period 1988 to 2007. The chosen funds are those which are at least two years old, are more than one year away from being liquidated, and have at least 10 years of data available (more detail on the samples is given in Appendix Table A2).

There are some interesting similarities and differences between funds in the US and UK. Funds in the US, at the median, differ from those in the UK in having: smaller discounts (8.9% versus 13.1%), larger expense ratios (1.56% versus 1.19%), and much higher dividend yields (5.81% versus 1.90%). Median expected lives can be calculated for the two samples from fund ages, using the empirical relationship reported earlier in Figure 7. The result is that median expected lives are similar in the two samples: 16.2 years in the US and 17.6 years in the UK.

[10] One counter-intuitive feature demonstrated by the table is that a larger dividend yield has a negative (rather than positive) impact on the premium if a fund is already trading at a premium. For example, a fund with a 10-year life, a 0.75% expense ratio, a 1% convenience yield and a 0% dividend yield has a premium of 2.36%. If the dividend yield rises to 6%, then the premium falls to 1.81%. The reason for this negative effect on the premium is that the larger dividend shortens the life over which the 'excess' benefits are accumulated and the excess benefits for such a fund are positive.

We cannot observe the convenience yield and so we calculate the level which it would need to take in order to generate the median premium in each market, using the model with the median levels of the other variables. The results are reported at the bottom of Table 2. For the UK the required convenience yield is 0.17% per annum and for the US it is 0.61%. These appear to be plausible values for seasoned funds. One reason why the convenience yield on US funds may be higher than on UK funds is that there are more US funds investing in emerging markets: 35% of the sampled US funds are in this category as compared with only13% of the UK funds.[11] Closed-end funds may therefore be offering US investors a way to diversify into 'exotic' investments, a feature for which there is less demand in the UK.

4.2 Tests on Seasoned Funds

Having calibrated the model successfully, we now proceed to a test, using panel data for the 170 UK and 93 US equity funds over the twenty years, 1988 to 2007. The data for each year are averages across weeks. Summary statistics and correlations are given in Appendix Table A2. The specification is:

$premium_{jt} = a + b\ E(life_{jt}) + c\ TER_j + d\ divyield_{jt} + e\ dum\text{-}MDP_{jt} + f\ exoticism_j + g\ \log(MV_{jt}) + h\ age\text{-}orthog_{jt} + i\ discount\text{-}index_t + error_{jt}$

where E(life) is expected life, TER is management expense ratio, divyield is dividend yield, dum-MDP is a dummy variable for the use of a minimum distribution policy, exoticism is a lack of correlation with the stock-market index, age-orthog is that part of age that is not explained by expected life, discount-index is an index of discounts on all equity funds, error is a disturbance term, j denotes fund and t denotes year.

The expected life of a fund is taken as the median for a fund of this age, using the relationship in Figure 7 above. The management expense ratio (TER) is obtained from Lipper and we use the median for each fund across the available years because of missing values and outliers in some years. Dividend payouts are from Datastream. Some US funds have minimum distribution policies (MDPs) and we use a dummy variable to take account of this feature, for each fund in each year. The convenience yield is proxied by two variables: the first is the market value of the fund - larger funds are expected to be more liquid; the second is the proportion of NAV returns which is not explained by the main stock-market index, which we denote as 'exoticism'. This variable is measured as $1 - R^2$ for a regression between returns on the relevant stock-market index and returns on the fund's NAV. The rationale for this variable is that it measures the extent to which a fund provides a means of investing in 'exotic' assets, for example country

[11] Country funds and emerging-market funds together comprise 48% of the US sample but only 26% of the UK sample.

funds or hedge funds.[12] We include current age as an indication of the extent to which management may be entrenched, leading to a larger discount. [13] However, because age is correlated with expected life, we use that part of age which is orthogonal to the expected-life variable, hence the 'age-orthog' designation in the specification.

The panel-regression results are given in Table 3, with the UK results in the left half of the table and the US results in the right half. For each of these halves, the first column gives either the size of coefficient predicted by the model for a small change around the sample mean, or, if the model makes no prediction about size, the expected sign of the coefficient is given. The variables are divided into a core set, which are those directly defined in the model, and a control set.

Starting with the core variables, the median expected life is significant (at the 1% level) for both markets and the coefficients on this variable are very close to predicted values: for the UK one year of extra life is predicted by the model to reduce the premium by -0.63% and the estimated coefficient is -0.52%; for the US one year of extra life is predicted by the model to reduce the premium by -0.28% and the estimated coefficient is -0.31%. This confirms that expected life matters for premia/discounts. The expense ratio also has a significant impact on premia in both markets (at the 1% level), but the effect is smaller than predicted by the model: -10.6% predicted versus -2.7% estimated for the UK and -8.35% predicted versus -2.4% estimated for the US. The dividend yield has no significant impact in the UK, but is highly significant in the US, although its estimated coefficient is only half as large as predicted. Of greater importance for the US is the presence of a minimum-dividend policy, which has a huge estimated impact on the premium of +9.6%.

Turning to the control variables, the two relating to convenience yield give rather mixed results. For the UK more exoticism is associated weakly with a smaller premium (only significant at the 10% level), whereas for the US there is a strong (and highly significant) positive impact of exoticism on the premium. These results are consistent with US investors seeking exotic funds but UK investors not doing so, as already noted earlier in the calibration. By contrast, the log of market value matters in the UK (at the 5% level), with larger funds commanding higher premia, but it does not matter in the US. The orthogonal component of fund age has a negative impact in both markets, but it is only significant (at the 1% level) for the UK where there are many old funds that have entrenched management. Finally, the discount index

[12] The exoticism variable is held constant for each fund across years.
[13] 24 of the 167 UK funds are over 100 years old, the oldest being 135 years. By contrast, the oldest US fund is 81 years of age.

has a strong influence on premia in both markets, with coefficients close to one, as would be expected if there is a tendency for the premia on all funds to move together.[14]

To summarise the panel results: the expected life has an impact on discounts in both the UK and US of the predicted size; the expense ratios matter in both markets; and that dividends matter in the US. In addition, US investors are attracted to exotic funds, whereas UK investors are attracted to larger and younger funds.

4.3 Test on Split-Capital Funds

There are two shortcomings in the panel regressions - first, it is necessary to compute the expected life of a fund from its current age and second, the ages are rather high. These limitations can be overcome by using a sample of 'split-capital' funds from the UK, which have pre-determined lives of ten years or less. Such funds prospered in the period 1994 -2001. The funds hold a single portfolio but issue more than one class of share. They may have separate classes of shares: 'income shares' paying all of the dividend; 'zero-dividend preference shares' with bond-like wind-up features; and 'capital shares' (if paying no dividends) or 'ordinary shares' (if paying dividends) and which are entitled to the residual value of the portfolio at maturity after all other claims have been met. The US equivalent is the 'multi-purpose' fund. There are no published discounts for these funds, but discounts can be calculated by comparing the aggregate market value of a fund's various different classes of share with the NAV of its portfolio. Gemmill (2007) reports that the discounts of split-capital funds averaged only 2.0% over 1998 to 2001, as compared with an average discount of 10.6% on equivalent conventional funds.

We use the whole population of split-capital funds in the UK, observed at the end of June in each of the years 1994 to 2001. As shown in the second column of Table 4, there are between 44 and 91 funds in a year, with an average maturity of 5.1 years (column 3). At first we considered using the dividend yield (aggregated across a fund's whole set of liabilities) as an explanatory variable. However, according to the model, the impact of dividend yield on the premium for such short-maturity funds is extremely small. [15] Instead we therefore include the leverage of a fund as a control variable (i.e. the percentage of debt in the

[14] The simple correlations between fund premia and the index of discounts for the relevant market are 0.28 for the UK and 0.34 for the US, as shown in Appendix Table A2. Note that including this variable in the panel, which is the same in a period for all funds, makes it impossible to have a fixed effect in the regression.

[15] For example, following a huge increase in dividend yield from zero percent to eight percent, a fund with five years to maturity might experience an increase in its premium of only 0.40%. This calculation is based on a fund with 5 years to maturity, 1.09% expense ratio, required return of 9%, convenience yield of 0.4% and dividend yield of 4%.

whole capital structure). As can be seen in column 4 of Table 6, leverage averaged between 37% and 53% in the sample years. Because of the high leverage, we adjust for the distortion which this has on the measured premium, as suggested by Cherkes, Sagi and Stanton (2009). The correction reduces the value of the premium or discount by between 1% and 4% on average in a particular year, as shown in columns 5 and 6 of Table 4.

The specification for each year's cross-section regression is

$\text{Premium-unleveraged}_j = a + b\,[\text{maturity}_j \text{ x } \text{indic}_j] + c\ \text{debt\%}_j + \text{error}_j$.

The maturity variable is multiplied by a dummy variable denoted 'indic_j' which takes on a value of –1 if the j^{th} fund is trading at a premium and +1 if it is trading at a discount.[16] Premium-unleveraged is computed by multiplying the leveraged premium by (1-debt%). Debt % is the market value of debt divided by the market value of debt plus equity. [17]

As reported in right-hand column of Table 4, the R-squared value for each year's cross-section is high, averaging 0.610. The effect of <u>maturity</u> is negative and significant at the 1% level in each of the eight years and one extra year of life leads on average to a -0.53% reduction in the discount. That is very close to what might be expected theoretically.[18] The effect of <u>debt</u> is positive in all years and significant at the 1% level in six of the eight years. Debt is used here as a control variable and we have no model-based prediction for the size of its coefficient. It is interesting to note, however, that debt has its weakest estimated effect in 2001, which is also when the stock market fell and the solvency of several split-capital funds was called into question.[19]

To summarise: the evidence from split-capital funds is highly supportive of the hypothesis that a shorter expected life has a positive impact on a fund's premium, with a magnitude that is consistent with the model.

[16] The dummy variable is needed in order to take account of the opposite effect of maturity for funds trading at premia as compared with funds trading at discounts. At maturity a fund must expire at a premium of zero. If a fund is trading at a premium, the longer the fund has to run the higher that premium can be and the effect of maturity is likely to be positive. If a fund is trading at a discount, then the converse argument holds and the effect of maturity is likely to be negative. The use of the 'indic_j' dummy variable allows for these opposite effects.

[17] The specification does not include the expense ratio, because the only reliable data are for the year 2000, when it averaged 1.09% across 73 of the 91 funds.

[18] For example, using the model with $r = 9\%$, $\gamma = 1.09\%$ (expense ratio), $\theta = 0.4\%$ (convenience yield), dividend yield = 4%, an increase in a fund's life from 4 years to 5 years would widen the discount from 2.37% to 2.90%, i.e. by -0.53%.

[19] The shares of many funds became worthless thereafter. The debacle was subsequently investigated by a House of Lords Committee and some retail investors, who had been misled, were compensated.

5. Calibration for New Issues

For a new issue to be possible, investors must perceive that its benefits are at least as large as the costs of issue, typically 3.5% in the UK and 5.0% in the US. These costs reduce the NAV. Suppose there are $100 of assets. If the issue costs are 5%, then the fund will have an initial NAV of $95 and at an opening price of $100 there will be an initial premium over NAV of 5.3%. The evidence from previous research indicates the average premium over NAV for equity funds at the time of issue is about 6% in both the UK and the US [20], which is therefore enough to cover the costs of issue.

We now make calibrations of the model for the UK and US, with the aim of replicating what happens to premia over the life of a representative fund from its birth at IPO until it is fully seasoned and 20 years old. To do this, it is necessary to make various assumptions about the levels of the determining variables and how they change over time. These are justified in turn.

The first such variable is the life that an investor would expect for a new fund. For purposes of calibration, we assume that an investor is well-informed and has the expectations revealed in section 2 of this paper, i.e. an expected life of 10.5 years at the time of issue, falling to 7.4 years at age four and then rising to a limit of 17.6 years at age eighteen. The short expected life of a new fund (relative to a seasoned fund) will have a positive impact on the premium over the first few years of life.

The second variable to consider is the management expense ratio. From examining the panel data on seasoned funds, the expense ratio is found to be negatively correlated with age: -0.55 in the UK and -0.42 in the US. However, these correlations are mainly due to the low expense ratios of very old funds. In the panels, funds that are less than five years old have median expense ratios of 1.52% in the UK and 1.75% in the US. Older funds have lower ratios, as indicated by the panel median values which are 1.19% and 1.56% respectively (see Table 2). For the calibrations we assume that expense ratios start at 1.52% in the UK and 1.75% in the US, falling to long-run levels of 1.19% and 1.56% respectively after five years.[21]

[20] Gemmill and Thomas (2016) for the UK. Shao (2016) and Cherkes, Sagi and Stanton (2009) for the US.

[21] Bradley, Brav, Goldstein and Jiang, (2010) Table 1, panel B also indicate that old funds in the US have lower expense ratios than new funds. Averaging across their table, for 1988 to 2002, old funds (being those existing in the sample for more than 3 years) have an average expense ratio of 1.66%, as compared with new funds with an average of 2.09%.

The third variable to consider is the dividend yield. This tends to rise with age in both markets, the simple correlations being +0.26 for the UK and +0.07 for the US. For the UK we assume that the dividend yield is 1.50% at issue, rising to the median of 1.90% by the age of ten. For the US we assume that the dividend yield is 4.00% at issue, rising to the median of 5.81% by the age of ten. An extra reason for assuming the dividend yield to rise with age in the US is the greater use of minimum distribution policies for older funds.

The fourth, and most contentious, variable required for calibration is the convenience yield, i.e. the hidden rate of return that investors obtain from being able to access the set of assets assembled by a new fund. In order for the model to replicate the patterns of premia followed by discounts in Figure 2, the convenience yield at the time of issue needs to be very large. Cherkes, Sagi and Stanton (2009) find that a level of 11% is required for calibration of their model. We also find that a level of 11% is needed, falling to the earlier calibrated median of 0.17% in the UK after seven years and to the calibrated median of 0.61% in the US after five years.

The assumed levels of the four variables over time are given in Table 5, with Part A for the UK and Part B for the US. The premia generated by the model for the UK and US are given at the top of parts A and B. Model premia of 6% in both markets turn into discounts of about 0.4% after one year and, after ten years, discounts have widened to 12.1% in the UK and 8.8% in the US. The patterns of premia and discounts generated from the calibrations are also plotted in Figure 11. The initial premia turn to discounts at a similar rate in the two markets, as the convenience yield falls from its initial level of 11%. The discount then drifts lower in the UK than in the US because of the lower dividend yield and smaller long-run convenience yield in that market. The 'kink' which can be observed in the increasing pattern of discounts around age four for both markets is due to the expected life of a surviving fund reaching its minimum of 7.4 years at that age, after which expected life starts rising again and causes the discount to widen. Note that the premia and discounts here are 'fair' values, as emphasised by Berk and Stanton (2007), in the sense that they reflect the present value of the whole stream of time-varying costs and benefits until the expected liquidation of a fund.

For the pattern of Figure 11 to be generated, the most critical element is the initial large size (11%) and subsequent decline (to 0.17% in the UK and 0.61% in the US) of the convenience yield. We will now examine three different reasons why this implied pattern might arise: (i) new funds may perform well (net of manager fees); (ii) new funds may provide cheap access to illiquid assets; and (iii) investors may have biased expectations of returns. These will be considered in turn.

(i) Convenience Yield and Fund Performance Net of Manager Expenses

Berk and Stanton (2007) generate a premium in their model by assuming that new funds have low expense ratios and, on average, perform better than the market. We have already noted above that expense ratios on new funds are not low, but high. There is also evidence that the average fund does not outperform the market. Gemmill and Thomas (2016) find that new funds in the UK perform worse (in terms of NAV returns) in their first year than the market as a whole by about 3% and worse than their own particular benchmarks by about 1%. Similarly, Shao (2015) reports that new equity funds in the US perform worse, in terms of price returns, than matched samples of old funds by as much as 25% over one year. Given that discounts on equity funds are 8% after one year in her study, that suggests that new US funds perform worse in terms of NAVs by around 17% over that period. There is therefore strong evidence that abnormally good performance, net of expenses, does not explain the premium on a new issue.

(ii) Convenience Yield and Liquidity

The second possible reason for the IPO premium is a liquidity gain from being able to invest in an illiquid sector, (Cherkes, Sagi and Stanton, 2009). For the premium on an IPO to become a discount after only one year, the convenience yield has to fall very quickly, as demonstrated by our calibrations. However, Gemmill and Thomas (2016) do not find any significant changes in the liquidity of assets held by UK funds during their first three years after an IPO.

There is also a problem related to the magnitude of the convenience yield necessary to generate the required premium. The work of Lesmond and Nishiotis (2015) is helpful in this regard. They report that during the Asian financial crisis of 1997, closed-end funds investing in Thailand, Indonesia and South Korea traded at very large premia, in some cases of over 100%.[22] According to Lesmond and Nishiotis, during the Asian crisis the bid/ask spread on fund assets rose to about 7%, while the bid/ask spread on fund shares was only 2%: a bid/ask difference of 5% between the fund price and the fund assets. This may be compared with a bid/ask difference under normal market conditions of 1.3%, at which time the premium on the funds was about zero. The question then is whether an extra gain of 3.7% in the bid/ask difference is likely to bring about a move from a premium of zero to a premium of 50-100%? According to our model, if the bid/ask gain of 3.7% was to continue forever then the answer would be 'yes', a premium of 80% would be possible. But if the bid/ask gain were expected to persist for one year or less,

[22] Levi-Yeyati and Ubide (2000) observe a similar change for funds investing in Mexico at the time of the currency crisis in 1994.

which is what happened, then it might generate a premium of only about 3%. The temporary change in liquidity was therefore very unlikely to be the cause of the run-up in the premium during the crisis.[23]

(iii) Convenience Yield and Limited Rationality

New funds are launched at premia in the UK when there are some existing funds in the same (very specific) sectors that already trade at premia (Gemmill and Thomas, 2016). Shao (2015) reports broadly similar findings for the US. There must therefore be a particular feature of such sectors that attracts investors. Premia on sectors are related to contemporaneous flows into open-end funds, suggesting that investors are influenced by time-varying sentiment about the future performance of sectors (Gemmill and Thomas, 2002). IPO premia are also related to market-wide sentiment, as measured by the average premium on all closed-end funds and by an index of investor sentiment (Gemmill and Thomas, 2016).[24] In sum, it seems quite plausible that biased expectations (due to time-varying investor sentiment) play an important role in the IPOs of closed-end funds.

Our general conclusions on the new-issue puzzle are as follows. While the short expected life of a new fund reduces its discount, an extremely large convenience yield is needed in order to generate a premium that covers issue costs. Explaining such a large and temporary convenience yield is difficult in the framework of a 'fair' discount. Neither good asset performance nor liquidity gain is supported empirically as the cause. Biased expectations are a much more likely explanation.

6. Conclusions and Discussion

We have shown that discounts on seasoned closed-end funds are consistent with a rational model. What previous research has omitted, in particular, is the fact that funds have limited lives. When funds die, investors are paid-out the value of the assets (less some small costs) and the discount approaches zero. A rational investor knows that a seasoned fund has an expected life of less than 20 years and that prevents discounts from becoming very large.

We have also shown that dividends play a large role in determining discounts, unless a fund has a very short expected life. A dividend payment is equivalent to part of a fund being liquidated at a discount of

[23] Levi-Yeyati and Ubide (2000) attribute the premium during the Mexican crisis to local (Mexican) investors over-reacting to information, possibly because they needed to make fire sales for reasons of solvency.

[24] The US regression results of Cherkes, Sagi and Stanton (2009) relating to sectoral premia are also, in our judgement, at least as supportive of sentiment as the cause of premia as they are of time-varying liquidity.

zero. Large pay-out rates therefore reduce discounts. This helps to explain why some funds, particularly in the US, promise to make very large payments to investors via minimum-distribution policies.

We find that it is not possible with the rational model to explain the pattern of premia, followed by discounts, on new funds unless there is some extraordinary hidden gain over the first year of a fund's life. The gain needs to be about 11%, in both the UK and the US. This cannot be explained by the out-performance of new funds; new funds do not out-perform. Nor can it be explained by the gain from accessing illiquid assets, which is not large enough. The balance of the evidence therefore suggests that investors in new funds are simply too 'optimistic' in their expectations of returns.

Future research might be directed to unravelling the reasons for these biased expectations. According to Hanley, Lee and Seguin (1996) and Shao (2015), the bias in the US is generated from the marketing process, but we have shown that the same bias exists in the UK and the marketing of funds there is different. In addition, the marketing argument is not consistent with there being premia on existing funds in the same sector at the time of a new issue (Gemmill and Thomas, 2016). This leads to the question of who would buy a new fund, losing 3.5% to 5% in issuing costs, when there are already similar funds in existence? Perhaps it is investor sentiment which explains time-varying premia in different sectors (e.g. Gemmill and Thomas, 2002), but marketing is required to disguise the extra costs of such an issue. The research agenda then needs to address two questions: first, what drives time-varying sentiment; and second, how does the marketing process confuse individual investors?

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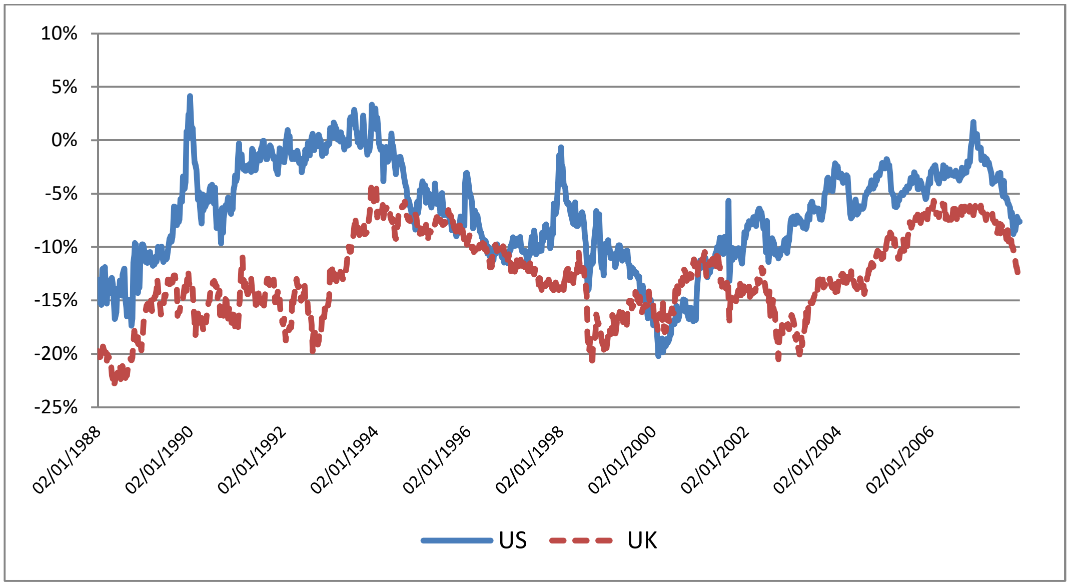
Figure 1

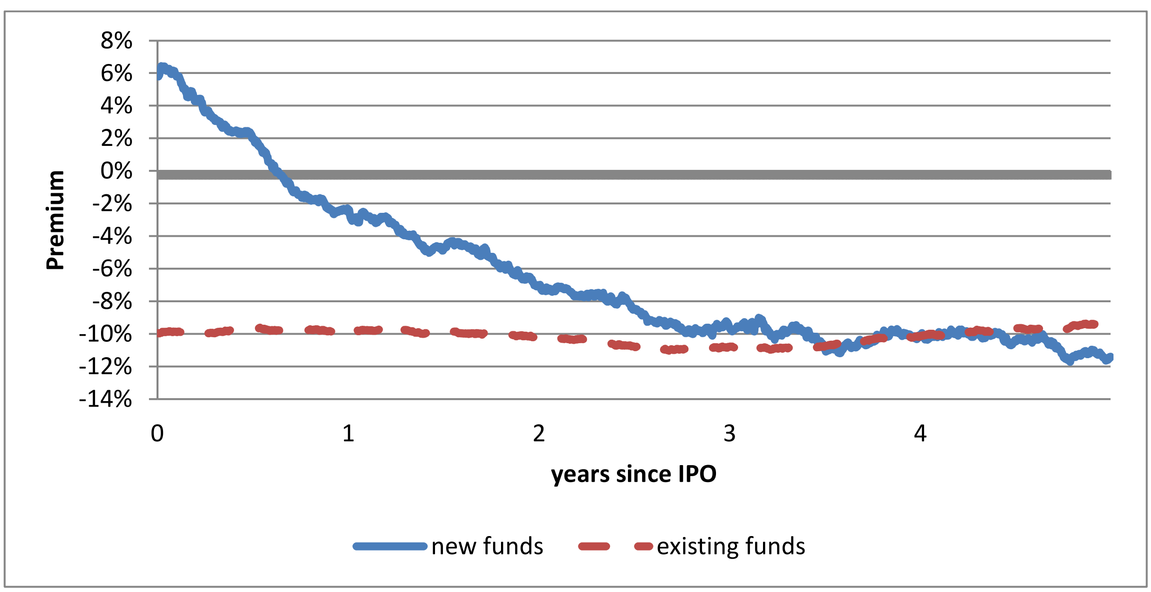
Average Premia and Discounts on US and UK Closed-End Equity Funds



Note: The data are taken from samples of 170 UK and 93 US equity funds observed weekly over 1988 to 2007. The sources of the samples are Datastream for the UK and Morningstar for the US.

Figure 2

Premia and Discounts on UK IPOs Compared with Average Discounts on Seasoned Funds, in Event Time



Note: This is an event-time plot from Gemmill and Thomas (2016) and relates to 261 IPOs in the UK over 1984 to 2008. The continuous line is the average discount across the 261 funds. The dotted line represents the average of the contemporaneous discount on all equity funds, sourced from Datastream.

Figure 3

Mortality and Age of Fund

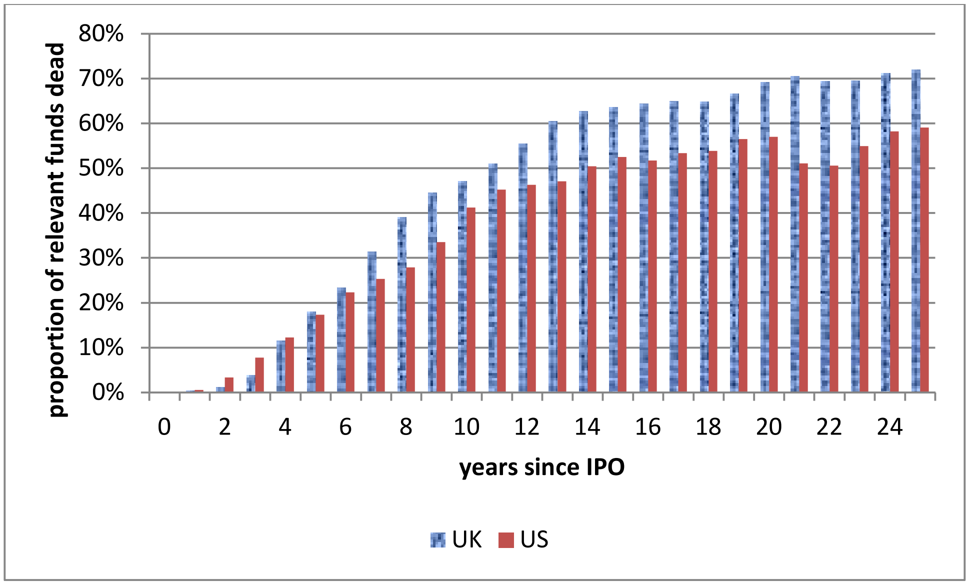


Figure 4

Fitted Trends for Mortality and Age of Fund

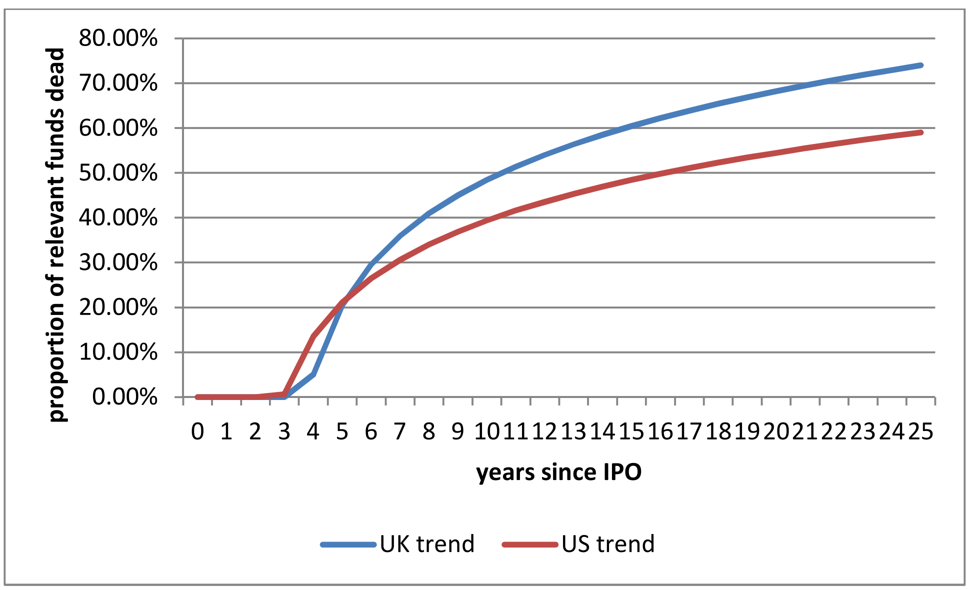


Figure 5

Distributions of Ages for Existing UK and US Funds (funds less than 50 years old)

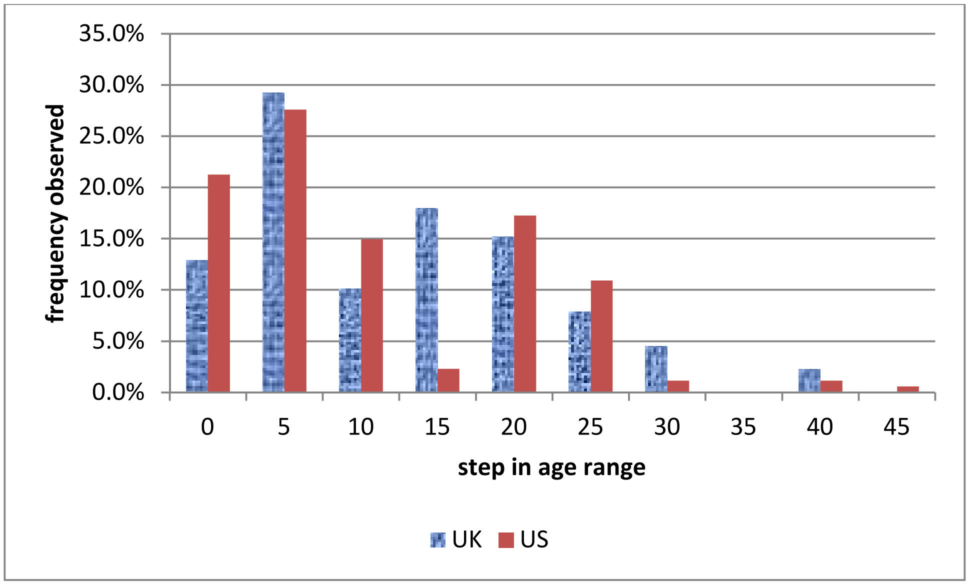


Figure 6

Trends Fitted to Distributions of Ages for UK and US Funds (funds less than 50 years old)

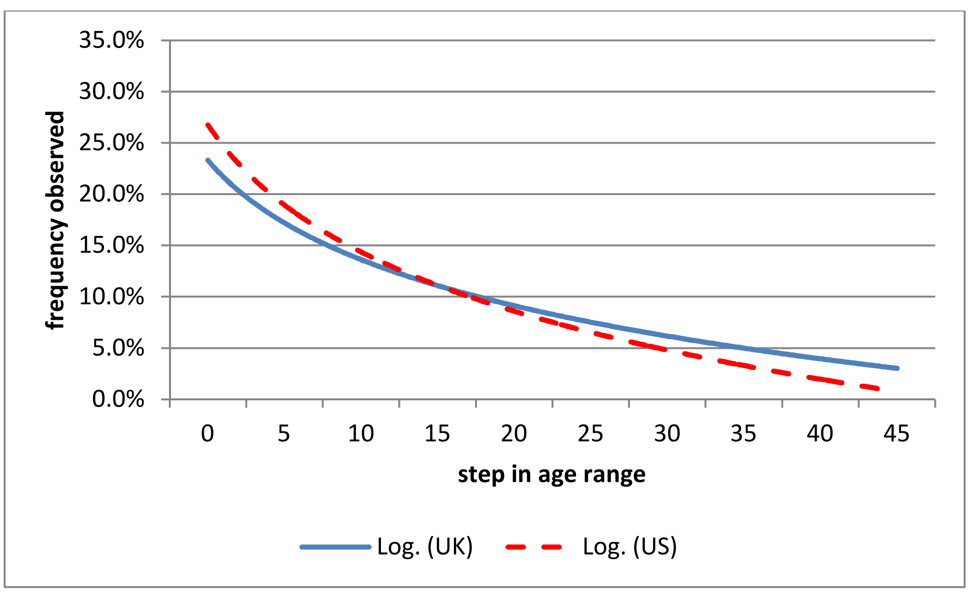


Figure 7

Median Life-Expectancy of UK Funds, Conditional on Current Age

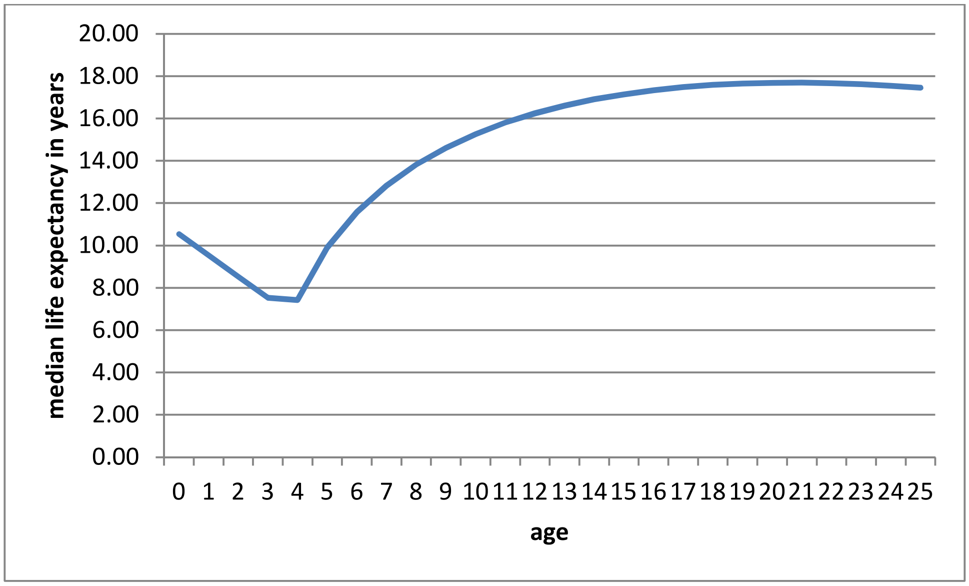
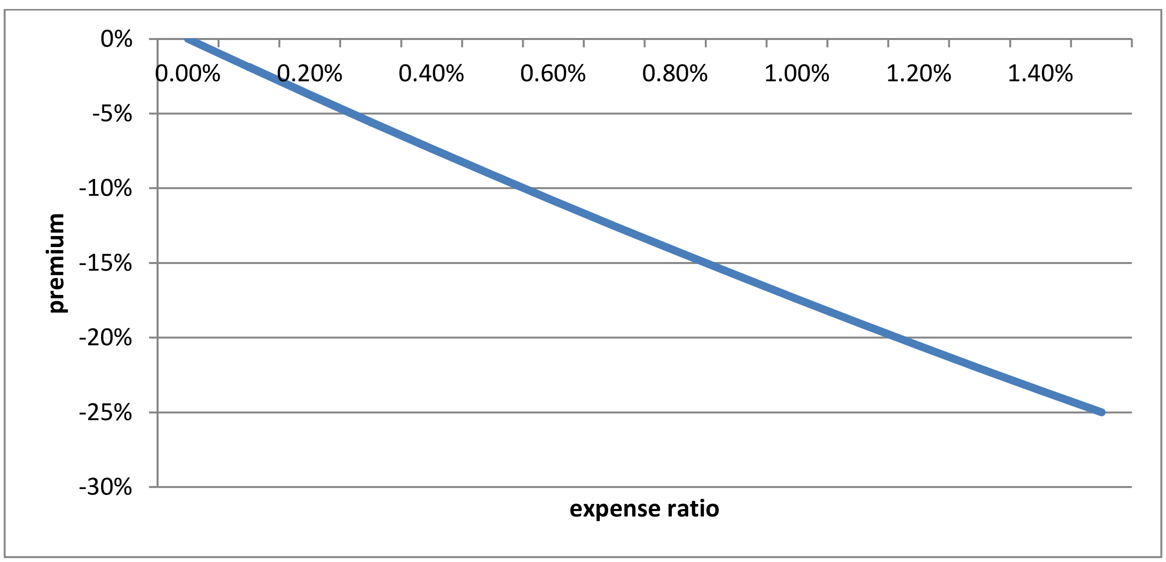


Figure 8

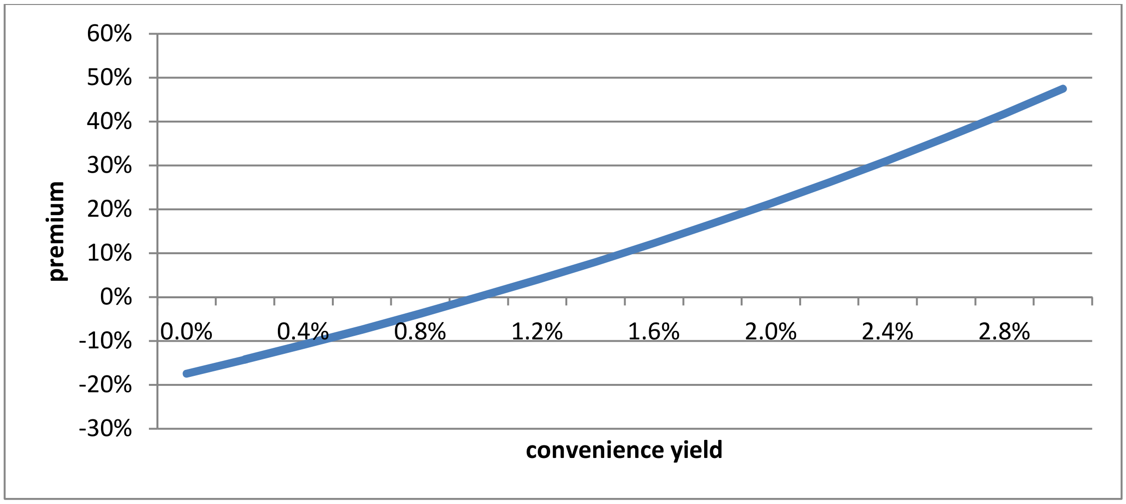
Premium as a Function of Management Expense Ratio



Note: plot based on a required return of 5%, an expected life of 20 years and a fund paying no dividends.

Figure 9

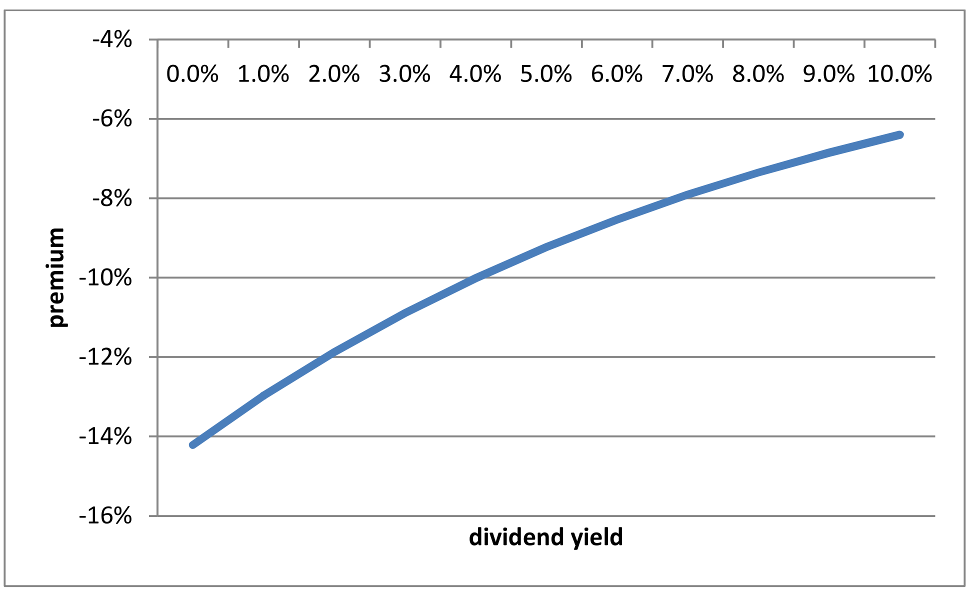
Premium as a Function of Convenience Yield



Note: plot based on a required return of 5%, an expected life of 20 years, no dividend and an expense ratio of 1%.

Figure 10

Premium as a Function of Dividend Yield



Note: plot based on a required return of 5%, an expected life of 20 years, an expense ratio of 1% and a convenience yield of 0.2%.

Figure 11 Calibrated Premia/Discounts on New Issues

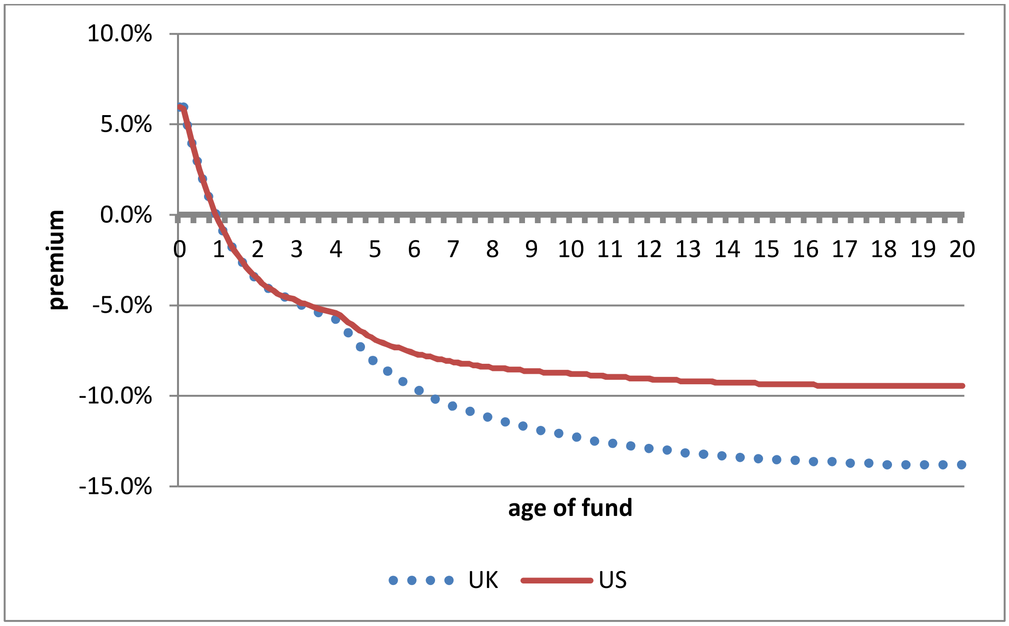


Table 1

Model Premium (+) / Discount (-) as a Function of Expected Life, Expense Ratio, Convenience Yield and Dividend Yield

Factor Level				Premium (+) / Discount (-)
Expected Life n	Expense Ratio γ	Convenience Yield θ	Dividend Yield δ	
10	0.75%	0.20%	0.00%	-4.99%
10	0.75%	0.20%	6.00%	-3.84%
10	0.75%	1.00%	0.00%	2.36%
10	0.75%	1.00%	6.00%	1.81%
10	2.00%	0.20%	0.00%	-15.50%
10	2.00%	0.20%	6.00%	-12.02%
10	2.00%	1.00%	0.00%	-8.96%
10	2.00%	1.00%	6.00%	-6.92%
20	0.75%	0.20%	0.00%	-9.72%
20	0.75%	0.20%	6.00%	-5.81%
20	0.75%	1.00%	0.00%	4.78%
20	0.75%	1.00%	6.00%	2.81%
20	2.00%	0.20%	0.00%	-28.59%
20	2.00%	0.20%	6.00%	-17.49%
20	2.00%	1.00%	0.00%	-17.12%
20	2.00%	1.00%	6.00%	-10.32%

Note: the computations assume a required return of 8%.

Table 2 Median Observed Variables and Imputed Convenience Yields for Seasoned Funds in the UK and US

sample values	UK	US
discount	13.06%	8.90%
expense ratio p.a.	1.19%	1.56%
dividend yield p.a.	1.90%	5.81%
median expected life in years	17.58	16.24
required return p.a.	9.20%	8.40%
convenience yield p.a. required to give observed discount	0.17%	0.61%

Note: The initial samples are weekly values for 170 UK and 93 US seasoned funds over 1998 to 2007. These are then averaged to give a single value for each fund in each year. The average is then found for each fund across all years and the table gives the median of these fund-average values. From an initial sample of 176 UK funds, six are excluded because they have expense ratios exceeding 5%. From an initial sample of 96 US funds, one is excluded because of missing data on its expense ratio and a further two because of missing data on market values.

Table 3: Panel Regression Results to Explain Premia/Discounts for Seasoned UK and US Funds over 1988 to 2007

Item	UK				US			
	predicted size of coeff. from model, or sign only	estimated coefficient	t-statistic		predicted size of coeff. from model, or sign only	estimated coefficient	t-statistic	
Core Variables								
median expected life	-0.63	-0.519	6.60	***	-0.28	-0.310	2.92	***
expense ratio	-10.65	-2.728	4.67	***	-8.35	-2.389	2.53	***
dividend yield	0.86	0.161	0.90		0.43	0.197	3.72	***
minimum dividend policy					+	9.622	9.10	***
Control Variables								
exoticism	+	-2.616	1.89	*	+	11.275	5.46	***
log of market value	+	0.682	2.50	**	+	0.025	0.06	
age of fund (orthogonal)	-	-0.053	5.17	***	-	-0.006	0.27	
discount index	+	0.732	17.93	***	+	0.910	13.73	***
constant		1.525	0.73			-5.230	1.46	
Statistics								
R-squared		0.2277				0.3636		
Funds included		170				93		
Years included		20				20		
Total panel observations		2726				1453		

Notes: The dependent variable is the average premium/discount in percent of a fund in a particular year. The method is GLS, correcting for cross-sectional correlation (i.e. clustered by period). The t-values are based on White standard errors which are corrected for time-series correlation. ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

Table 4 Regression Results to Explain Premia on UK Split-Capital Funds

year	number of funds in year	average years to maturity	average debt %	average premium %	average premium unlevered %	coefficient on time to maturity	t value		coefficient on debt	t value		R-squared
1994	52	6.00	36.5	3.70	1.27	-0.6228	-5.63	***	0.0393	1.66	*	0.596
1995	51	5.47	39.7	-3.34	-2.23	-0.3938	-5.58	***	0.0480	3.05	***	0.480
1996	44	5.07	42.8	-7.61	-4.62	-0.7946	-6.08	***	0.0826	3.63	***	0.553
1997	52	5.01	43.8	-8.37	-5.75	-0.3346	-3.31	***	0.1747	7.17	***	0.734
1998	49	4.82	39.4	-2.33	-1.83	-0.5219	-6.86	***	0.0730	2.88	***	0.643
1999	50	4.79	41.3	-5.55	-3.66	-0.5799	-7.22	***	0.1313	5.49	***	0.610
2000	73	4.60	46.2	-3.04	-2.29	-0.3961	-6.68	***	0.1192	5.73	***	0.703
2001	91	5.09	52.9	4.57	1.87	-0.6181	-7.55	***	0.0201	1.09		0.560
mean	57.8	5.10	42.8	-2.74	-2.16	-0.5327	-6.11		0.0860	3.84		0.610

Notes: The dependent variable is the unleveraged premium on a fund at the end of June in a year. The standard errors are corrected for heteroscedasticity (White method). ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

Table 5 Data on Calibration for New Issues in the UK and US

Part A

UK	end of year					
	0	1	5	10	15	20
premium / discount	5.95%	-0.42%	-8.18%	-12.25%	-13.48%	-13.80%
median expected life in years	10.53	9.53	9.90	15.26	17.14	17.58
expense ratio	1.52%	1.45%	1.22%	1.19%	1.19%	1.19%
dividend yield	1.50%	1.54%	1.70%	1.90%	1.90%	1.90%
convenience yield	10.60%	5.83%	0.53%	0.17%	0.17%	0.17%
required return	9.20%	9.20%	9.20%	9.20%	9.20%	9.20%
issue costs	3.50%					

Part B

US	end of year					
	0	1	5	10	15	20
premium / discount	5.95%	-0.37%	-6.92%	-8.80%	-9.36%	-9.44%
median expected life in years	10.53	9.53	9.90	15.26	17.14	17.58
expense ratio	1.75%	1.65%	1.56%	1.56%	1.56%	1.56%
dividend yield	4.00%	4.14%	4.91%	5.81%	5.81%	5.81%
convenience yield	10.60%	6.57%	0.61%	0.61%	0.61%	0.61%
required return	8.40%	8.40%	8.40%	8.40%	8.40%	8.40%
issue costs	5.00%					

Note: assumptions concerning variable levels are discussed in the main text; the convenience yields are imputed in order to give the observed premia by year.

Appendix Table A1

Lives and Deaths of the 261 Funds with IPOs in the UK Sample

What happened to funds in sample	Number of funds	Percent of funds	Comments on payment to shareholders
Survived	106	40.6%	
Liquidated	50	19.2%	Paid NAV
Open-ended	46	17.6%	Paid NAV
Restructured into a new fund	19	7.3%	A cash exit at NAV was an option
Merged or acquired	18	6.9%	A cash exit at NAV was an option
Converted into a split-capital fund	15	5.7%	New funds started trading at premia
Lost closed-end status	7	2.7%	Unclear, but small funds
Total	261	100.0%	

Note: 261 IPOs from 1984 to 2008, with subsequent histories tracked to the end of 2015.

Appendix Table A2

Summary Statistics and Correlations for Variables Used in the Panel Regressions

SUMMARY STATISTICS UK FUNDS	premium + / discount -	expected life years	expense ratio	dividend yield	exot-icism	market value £m	age years	index of discounts
mean	-12.66%	15.58	1.29%	2.21%	54.80%	177.1	39.5	-10.10%
median	-13.06%	17.58	1.19%	1.90%	57.95%	77.0	18.3	-9.89%
max	69.24%	17.69	4.76%	16.87%	100.00%	2639.0	135.0	-4.07%
min	-68.59%	7.43	0.24%	0.00%	0.00%	3.0	2.0	-21.48%
SD	9.60%	3.19	0.72%	1.96%	29.49%	268.4	38.4	3.77%
observations	2723	2723	2723	2723	2723	2723	2723	2723
funds	170	170	170	170	170	170	170	170
CORRELATIONS								
premium	1.000	0.009	-0.165	-0.019	-0.162	0.061	-0.004	0.278
expected life		1.000	-0.309	0.148	-0.315	0.267	0.573	0.098
expense ratio			1.000	-0.131	0.509	-0.343	-0.550	0.082
dividend yield				1.000	-0.348	-0.019	0.271	-0.179
exoticism					1.000	-0.331	-0.448	-0.005
market value						1.000	0.497	0.151
age							1.000	-0.048
index of discounts								1.000

SUMMARY STATISTICS US FUNDS	premium + / discount -	expected life years	expense ratio	dividend yield	exot-icism	market value $m	age years	index of discounts
mean	-7.09%	14.95	1.57%	6.27%	75.95%	293.7	17.1	-7.13%
median	-8.90%	16.24	1.56%	5.81%	84.20%	138.6	12.0	-6.76%
max	64.58%	17.69	4.54%	45.16%	100.00%	3436.2	81.0	0.57%
min	-74.25%	7.43	0.45%	0.00%	18.90%	6.0	2.0	-17.03%
SD	13.20%	3.22	0.64%	6.14%	20.38%	408.8	17.0	4.28%
observations	1453	1453	1453	1453	1453	1453	1453	1453
funds	93	93	93	93	93	93	93	93
CORRELATIONS								
premium	1.000	-0.066	-0.050	0.133	0.040	0.069	-0.088	0.339
expected life		1.000	-0.166	0.076	-0.145	0.199	0.538	-0.091
expense ratio			1.000	-0.132	0.387	-0.363	-0.413	-0.030
dividend yield				1.000	-0.219	0.165	0.062	0.016
exoticism					1.000	-0.357	-0.408	-0.001
market value						1.000	0.453	0.020
age							1.000	0.026
index of discounts								1.000